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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

Annual Meeting of the Southwestern Gas Association.

DENISON, TEXAS, February 14, 1891.

To the Members and Expected Visitors:—We want to call your attention once more to the approaching meeting of the Southwestern Gas Association, to be held at the Menger Hotel, San Antonio, March 10th and 11th, and to beg of you for your own interests and the interests of the whole gas manufacturing fraternity of the great and growing Southwest to use every effort to be present. None of us can afford to forego the natural exchanges of thought and experiences arising from such a gathering of professional and otherwise interested men in a conventional manner. You owe your presence at the meeting to yourself, to your Company and to your fellow craftsmen, and none of us should be guided by selfish motives except where the gain shall be mutual and of the greatest possible good to all concerned. The gain to your Company will probably be very many times larger than the expenses of the time and trip. You will feel better for the meeting, too, and come back to your spring duties with better heart and grace. The meeting is so early in the year, and comes as it were between the busy manufacturing season and the vigorous repair and extension season so opportunely as to make a season of rest and recreation, which at the same time is spent in so profitable a way as to ingeniously combine pleasure and profit as nothing else could so well do.

The indications point to a well attended meeting and an exceedingly profitable time to all; but you, *you we say*, must make it a personal matter and duty to see that nothing prevents your coming—once there, and you will not regret it through the coming year. If you have a paper to write do the best you can with it, and do not anticipate what will follow—you are bound to do some one good by telling your experiences.

If you have any questions to ask, write them down on a slip of paper and send them to President Judge, of Austin, or put them in the box when you get there, and please do not forget that it is a case when you must "Get There." Respectfully,

WM. ENFIELD, Dallas, Texas.
J. R. CULLINANE, Denison, Texas,
Committee on Programme.

Programme.

Address of President, A. E. Judge, Austin, Tex.

"Advantages of a Gas Engineer Being a Member of a Gas Association," by the President.

"Gas Coals of the Southwest," by Wm. Enfield, Dallas, Tex.

"Condensation and Leakage in the Southwest," by C. P. Russell, Galveston, Tex.

"Regenerative Furnaces in the Southwest," by E. A. West, San Antonio, Tex.

"The Steam Jet Exhauster and Condensation," by J. C. Lord, Fort Worth, Tex.

"Candle Power in Competition with Electric Lighting," by Leonard Gill, Corsicana, Tex

"Electric Lighting in Connection with Gas Lighting: Comparative Prices and Profits of Each," by J. J. Walsh, Paris, Tex.

"Fuel Gas and Gas for Fuel," by J. R. Cullinane, Denison, Tex.

"Gas Making in the Southwest: Its Advantages and Disadvantages," by Joshua Gill, Houston, Tex.

"Market for Residuals in the Southwest," by J. L. Brockenborough, Waco, Tex.

"The Commercial Possibilities of Gas," by Thos. Miller, Fort Worth, Tex.

"The Gas Man's Easy Chair: Has he One?" by Maj. Davis, Sherman, Tex.

"Mains, Services and Drips," by Elmer Jones, Paris, Tex.

"Gas Stoves and a Special Price for Gas as Fuel," by G. R. Vaughn, Houston, Tex.

"The Alternating Current," by J. H. Maxon, Waco, Tex.

"Carrying Gas into Mexico and to Mexicans," by M. L. Hickey, El Paso, Tex.

[Official Notice.]

Ohio Gas Light Association.

Office of Secretary, Columbus, O., Feb. 10, 1891.

To Members of the Ohio Gas Light Association :

Gentlemen—The Seventh Annual Meeting of this Association will be held at Zanesville, O., on March 18 and 19, 1891.

The Clarendon, a first-class hotel, has been selected as the stopping place for our members. Its rate is $3 per day. Those intending to attend the meeting should write well in advance for rooms. *This is important.* In case you should fail to find accommodation at the Clarendon, the Kirk House, famous for its excellent fare, is near at hand.

The sessions of the meeting will be held in a large room, exactly suited to our needs, in an office building at the corner of Sixth and Market streets, on the same lot with the exhibition plant of the Ohio Fuel and Incandescent Lighting Company. It is in a quiet locality, about two blocks from the Clarendon.

The usual exhibit of gas stoves, burners, engines and other appliances and devices of interest to gas men will be held in a large, well lighted room on the ground floor of the Shinnick Building, on Main street, on the direct route between the Clarendon and the convention room. This exhibit promises to constitute a very interesting feature of the meeting.

The following papers have been promised, and probably one or two more will be announced later :

1. "The Proper Handling of Oxide of Iron in Purification," by H. W. Douglas, Ann Arbor, Mich.
2. "The Desirability of a Uniform System of Gas Companies' Accounts," by A. P. Lathrop, Columbus, O.
3. "How Small a Works can Profitably Utilize Its Ammoniacal Liquor?" by George Osius, Detroit, Mich.
4. "The Alleged Popular Prejudice against Gas Companies, and How Best to Eradicate it," by Eugene Printz, Zanesville, O.
5. "A Consideration of the Arguments for and against Water Gas, in 1891," by F. H. Shelton, Phila., Pa.
6. "Does Ohio Want a Gas Commission?" by Irvin Butterworth, Columbus, Ohio.
7. "The Present Outlook for Manufactured Fuel Gas," by George H. Christian, Jr., Norwalk, Ohio.

In addition to the foregoing papers, a "Question Box," which proved such a profitable and interesting feature of our meeting last year, will be had again this year, to which members are requested to contribute queries.

A good meeting is expected, and all members are earnestly urged to be present, prepared to participate in the discussions. Persons eligible for membership, who are not yet members, are cordially invited to attend this meeting and join the Association. Blanks for applying for membership furnished on application. Respectfully,

Irvin Butterworth,
Secretary.

[Circular No. II.]

Columbus, O., February 16, 1891.

To Manufacturers: Dear Sirs—In connection with the Seventh Annual Meeting of this Association, at Zanesville, O., March 18 and 19, 1891, there will be an exhibition of gas stoves, burners, engines, and any and all kinds of gas apparatus and other appliances of interest to gas men. You are hereby cordially invited and requested to contribute to this exhibit some article, or articles, in your line of manufacture.

A large and well lighted room, admirably adapted for the purpose, has been secured for this display. It is situated on the ground floor of a building a short distance from the Clarendon Hotel, where most of our members will stop, and on the route from the hotel to the hall in which our meeting will be held. There will be an excellent opportunity for the advantageous display of your specialties to the large number of practical gas men who will be in attendance, as well as to the Zanesville public.

No charge will be made for floor space, nor will exhibitors be at any expense whatever, except freightage to and from Zanesville.

Consignments of goods for the exhibit, and communications with reference thereto, should be sent to Mr. Eugene Printz, Superintendent Gas Light Company, Zanesville, O., who has charge of the display, and who will arrange the articles to the best advantage of all concerned.

Shipments should be made well in advance of the date of the meeting—as early in March as possible. *This is important.*

Respectfully,

Irvin Butterworth, Secretary.

BRIEFLY TOLD.

President Prichard's Address.—We may take it for granted that the address of President Prichard, at the coming of-age meeting of the New England Association, has received from our readers that share of consideration which its merit demands. As we said last week, it is a most admirable paper—even in sentiment, calm in argument, logical in deduction. Having dealt with matters fraternal in the opening passages, Mr. Prichard next voices the verdict of the Eastern gas men in respect to the teachings of the past twelvemonth as shown in the standing to day of the gas industry in the New England States. Steady-going New England, always alive to the suggestions of current practice, in the effect that the latter may exert on the future, reports continued prosperity as the portion of her gas makers. An all-round increase in sendout of 10 per cent. as an admitted fact must be very gratifying—to the engineers who provided for and supplied it, and to the proprietors who reaped the greatest money-benefit from it. In the art of the gas maker there is no such thing as over-production, hence an increase of 10 per cent. cannot mean goods stored away because they were made in excess of the demand, nor a sacrifice of them either to prevent such storage. The community that could show in a year, and from that year to another, an increase of 10 per cent. in population or wealth, would have much to congratulate itself over; but gas men take these things as a matter of course, chiefly accepting the last increase as an indication of what they must provide for in the future. Recognizing the fact that no radical advance was made during the year in either methods or processes, Mr. Prichard refers to the pleasing fact that a marked advance in the demand for and price of residuals was experienced, and having also referred to the auxiliary water gas apparatus as a more than safeguard to the coal gas maker, he makes mention of the irregular state of the gas coal trade last year, and the cost thereof to the proprietors of gas companies. During the continuance of the disagreement between the colliery proprietors and their men the Journal held its peace, in the complete knowledge that anything we might say would be unacceptable. Now, however, we wish to put ourselves on record in the statement that the mine owners had every right on their side, and that were it not for the stand assumed by them and maintained with such firmness, the chance, for cheaper coal gas, at any rate, would have been put a long time off. The miners were not unfairly dealt with; and although much anxiety was occasioned many of our engineers, and much added expense as well, the mines' proprietors were the recipients of a full larger measure of the anxiety and the loss. Having paid his respects to the agitators of municipal lighting, and having given a goodly share of attention to electric lighting, Mr. Prichard pays attention to the subject of artificial fuel gas. Here he is (speaking with the authority of one who was practically in fuel gas, when others were asking themselves what was meant by it—at Lynn in 1885), repeating with emphasis the findings of 6 years ago. His paper on this subject—see Journal, March 2, 1886, p. 125—before the New England Association is as live to-day as it was then, which brings to mind the proverb to the effect that he who travels slowly travels safely; and he who travels safely travels far. Promptness of decision and speed of action are all very well when "the devil drives," but that driver does not often hold the reins on the gas makers' highway. Mr. Prichard's fuel gas opinions are founded on experience, and are so legibly transcribed that one has no trouble in reading them easily. His address was timely, terse and truthful.

Our Current Notices.—We call especial attention to our current official notices, as many changes have been made in them, over those that appeared a fortnight ago. This is especially noteworthy in the Southwestern instance, the Programme Committee of which Association is evidently fully alive to duty. We also call attention to Secretary Butterworth's circular to the manufacturers of gas apparatus inviting them to forward their goods for disply at the Ohio Association's exhibition annex. Last year's exhibition was most creditable to its organizers and the exhibitors, and very entertaining to the visitors.

The Western is Getting Ready.—Brother Barret, of Louisville, has been looking up ancient and modern authorities on certain practices connected with the entertaiment of large bodies, hence we take it (remembering his natural proficiency on this score) that the Western Association's XIV. annual will be, in so far as its social side is concerned, "a thing of beauty and a joy forever." We also have an inkling to the effect that eight papers are promised, and that President Egner and Secretary Littleton are still twirling the lariat. The wide-awake Secretary will be heard from at the right moment.

[Official Report.—Revised by the Secretary.—Continued from page 263.]

TWENTY-FIRST ANNUAL MEETING OF NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Held at Young's Hotel, Boston, Mass., Feb. 18 and 19, 1891.

First Day—Wednesday, Feb. 18—Morning Session.

Two Invitations.

The Secretary—I have received the following invitations:

The Gas Appliance Exchange,
Boston, Mass., February 17, 1891.

Mr. Chas. F. Prichard, President, New England Association of Gas Engineers:

My Dear Sir:—We would respectfully request the members of the New England Association of Gas Engineers to visit the Gas Appliance Exchange, 134 Congress street, and inspect the line of gas appliances on exhibition and in operation.

We would also extend to them a cordial invitation to be at the Gas Appliance Exchange, on Thursday, 12 o'clock, for lunch.

Very truly yours,
The Gas Appliance Exchange,
Dwight T. Cortis, Supt.

Office Thomson Houston Electric Company,
Boston, Mass., Feb. 16, 1891.

Charles F. Prichard, Esq., President New England Association of Gas Engineers:

Dear Sir—I am requested, in behalf of the Thomson-Houston Electric Company, to invite the members of your Association to an inspection of the factory and shops of the Company at Lynn, Mass., at the close of your meeting on Thursday, or at such time as will be agreeable to you. Cars will be provided on the Narrow Gauge Road, and other conveyance to and from the factory, at such time as you may designate.

We shall esteem it a favor if the Association shall see fit to accept the invitation. You will consult with me in regard to any further details that may be necessary at your convenience. Yours very truly,
Robt. B. Taber, Agt.

The Secretary—These letters were brought to the attention of the Directors last night, who recommended that they be read to the Association, and that the invitations be accepted with thanks. If you decide to accept the invitation to visit Lynn, the recommendation of the Directors is that the members leave here at 12 o'clock to-morrow, go directly to the Gas Appliance Exchange, and then take the cars for Lynn at 2 o'clock.

On motion of Mr. Harbison the recommendation of the Directors was approved, and the invitations were accepted, with thanks.

Report of Treasurer.

The Treasurer read the following report, which was, on motion of Mr. Stiness, approved and placed on file:

Charles H. Nettleton, Treasurer, in account with the New England Association of Gas Engineers.

Receipts.

1890. Balance			$111 23
Received dues, 1888		$3 00	
" " 1889		9 00	
" " 1890		39 00	
" " 1891		267 00	
			318 00
Admission fees, meeting 1890			85 00
Dinner tickets sold, 1890			192 00
Interest, Derby Savings Bank			30 37
			$736 60

Expenditures.

Expenses of meeting of 1890—		
1890. Young's Hotel		$291 00
Printing, stationery, etc.		119 67
		$410 67
Expenses of meeting of 1891—		
1891. Printing, stationery, etc.		22 05
Directors' meeting, Jan. 9, 1891		26 30
Charles H. Nettleton, salary		200 00
Balance		77 58
		$736 60
Permanent fund deposited in the Derby Savings Bank		$600 00

Elected to Honorary Membership.

The President—The Directors have a recommendation which they make through the Secretary.

The Secretary—The Directors recommend the election of Mr. William W. Greenough, of Boston, and Captain William Henry White, of New York, as honorary members of this Association.

Mr. Harbison—I move that the recommendation of the Directors be adopted by the Association, and that Mr. Lamson be authorized in behalf of the Association to cast the ballot of the Association for the election of those gentlemen as honorary members.

The motion was agreed to, the ballot was taken, and Mr. Greenough and Mr. White were declared elected honorary members.

On motion of Mr. Stiness the Secretary was directed to notify Mr. Greenough and Mr. White of their election.

Committee on Nomination of Officers.

On motion of Mr. Harbison the Chair appointed the following committee to nominate officers for the ensuing year: Messrs. J. P. Harbison, F. W. Norton, H. A. Atwood, C. F. Spaulding and H. F. Coggshall.

Committee on Visitors.

Mr. W. A. Wood moved that a committee of two be appointed to extend the courtesies of the Association to visiting gas engineers. The motion prevailed, and Mr. W. A. Wood and Mr. M. S. Greenough were appointed as such committee. They subsequently reported that they had extended invitations to the following named gentlemen to attend the meetings of the Association:

Barker, F. E.	Faben, Jr., C. R.	McDonald, Wm.
Beal, Wm. R.	Flemming, D. D.	Page, G. S.
Blodgett, C. W.	Garrett, Jesse.	Perkins, J. D.
Bush, J. S.	Graeff, G. W.	Russell, D. R.
Corbett, C. H.	Hayward, S. F.	Sanderson, C. E.
Daly, D. R.	Isbell, C. W.	Shelton, F. H.
Dickey, C. H.	Kreischer, G. F.	Weber, O. B.
Dingee, F. A.	Lansden, T. G.	Whittier, J. P.

Reading the Papers.

Mr. George F. Goodno, of Dedham, Mass., read his paper, entitled

SOME EXPERIMENTS ON THE RATE OF PURIFICATION.

Of all the processes in gas making, from the retort to the holder, none, perhaps, has been more studied and written about than purification; meaning in this case the removal of sulphur and other compounds by means of iron oxide or lime, or both. But nothing seems to have been established as to the best rate of flow per bushel, or per cubic foot, of purifying material. Several authorities give figures for makes of 24 hours, but no two of them seem to agree.

Being entirely a chemical process, it requires time, and we are not likely to err on the side of giving it too much, and time in this case is synonymous with large boxes. With a view to ascertaining within practical working limits the amount of gas that can be purified per bushel at different rates of flow per hour, a small experimental purifier, holding one-tenth of a bushel, was connected to the outlet of the second purifying box, thus putting it in the same position that a new clean box would be in. At the outlet of the small purifier a meter was connected. The purifier was first filled with manufactured iron sponge, well moistened and oxidized, such as we have in general use. At first gas at the rate rate of 200 feet per hour per bushel was run through without showing any color on moistened acetate of lead paper, and from that gradually up to 600 feet per bushel per hour when the color was distinctly visible, as you well might expect. Not that the sponge had been used up, for that could hardly be, but because chemical action was not rapid enough to effect a combination with all the contained sulphur. The flow was now reduced to 30 feet per bushel per hour, and thus chemical action was rapid enough for the sponge to do its work, and the gas showed no color. The flow was then gradually increased at regular intervals to 100, then 150, 240, 300 and 400 feet per bushel per hour, when the lead paper again showed color. The flow was again decreased to 60 feet per bushel per hour, and allowed to run at that rate until the sponge was used up, which occurred when about 3,000 feet to the bushel had passed. An examination of the sponge showed that a very considerable portion was still oxide, which was to be expected, as the same sponge in regular use in the boxes was purifying 5,000 feet per bushel at the rate of 23 feet per bushel per hour. Some have observed that a box would show hydrogen sulphide one day, and the next that it could not be detected. It would seem that a decrease in the rate of flow, as in above case, would account for such a state of affairs. Averaging the extremes of each year for the past two years in our works, I find the figures in

actual work bear me out in this supposition. The sponge was the same, and the coal from the same mine.

1889.	Ft. per Bush.	Ft. per Day.	Ft. per Hour.	Ft. per Bush. per Hour.
December and June..	4,420	33,600	1,400	28
March and September.	8,050	20,970	874	17
June and May.....	8,720	14,800	608	12
1890.				
December and June..	4,660	32,800	1,366	27
March and September.	7,480	18,550	773	15
May and June.....	8,530	13,300	554	11

The small experimental purifier was now filled with lime, moistened and mixed with breeze, and the action of the gas found to be considerably different from that on the sponge. The rate was at first fixed at 660 feet per bushel per hour. The sponge at this rate showed color almost immediately, but to my surprise the lime gave no such results until about an hour, after which the flow was reduced to 60 feet per bushel per hour, but the change was less marked than with the sponge, for the gas continued to show color for some time, but ceased in an hour or so, and did not appear again until about 2,000 feet per bushel had passed through. The lime after this operation appeared to be fouled around the sides of the purifier, but in the center was as white as ever; the too rapid passage of the gas had formed an impervious shell about the outside, so the gas could not act on the interior. From others' experience, I learn that when the rate of flow is not excessive, the difference between the amount purified with lime per bushel in winter and summer is not observable. But with any ordinary sized boxes with sponge, the fact is patent. The size of our boxes is 6 x 10 feet, and 50 bushels are used in a charge to each box, and the amount purified per bushel in summer is almost double that in winter, as will be seen from the table. This fact becomes all the more observable where water gas is made in connection with coal gas, and the mixture pushed through much faster during a few hours a day.

It might be interesting to speculate why this marked difference between iron sponge and lime in the rapidity of their action. In one case, as is well known, the chemical agent is hydrated sesquioxide of iron, and in the other, hydrate of calcium, according to the familiar equations:

$$Fe_2 O_6 H_6 + 3 H_2 S = 2 Fe S. + S + 6 H_2 O \quad (1).$$

$$Ca (O H)_2 + H_2 S = Ca S. + 2 H_2 O \quad (2).$$

According to chemical authorities, calcium is a more positive element than iron, and consequently would have a greater affinity for the negative element, sulphur, a fact which our practical working bears out.

The conclusions derived from the study of this subject are: that for a given make of gas smaller boxes may be used for lime than for sponge or native oxide, and that with a fairly good sponge to secure an efficiency of 5,000 feet to the bushel, with the maximum winter make, each box should not be smaller than one bushel capacity for each 20 cubic feet per hour, or, in more convenient terms, 2½ cubic feet for each 1,000 cubic feet of gas made per 24 hours; and I think, farther, that the capital would be well invested if they each had a capacity of 4 cubic feet for each 1,000 cubic feet of gas made per day. In fact, in any works there seems to be little danger that the purifiers will be made too large.

Discussion.

The President—We shall be glad to hear from anyone who has had experience in changing four or five boxes per day, this last winter. Mr. Allyn has been getting some remarkable results in the amount purified per bushel, and we would like to have his experience.

Mr. Allyn—I suppose I have had the same ups and down that almost every member of the Association has had. For a time the purification goes on nicely and smoothly, and then, all of a sudden, the purifiers will take it into their heads to kick. Then we have a good deal of amusement for another short space of time. We have more difficulty in times of the largest production of gas, from a formation, as Mr. Goodno has said, of a shell on the under side of the purifying material. Sometimes this shell will form within a few hours from the time of charging the purifier with fresh oxide. We think that everything is all right, but in a few hours this shell, of not more than three eighths or one-half an inch in thickness, will form. It is almost entirely impervious to the passage of gas, and as the pressure will keep increasing, our only resource is to change the box.

Mr. E. C. Jones—I have been brought to a realization of the truth of Mr. Goodno's statement, that the larger the purifiers the greater will be he amount of gas purified per bushel of lime. In 1884, when we started with the new South Boston Works, it was quite an object for us to change from 10 by 10 to 14 by 18 purifiers. We found that the amount of gas purified per bushel of lime increased very rapidly. In regard to this crust which forms on the under side of the purifying material, I may say I have had a peculiar experience this winter with it. I rise now to speak in the hope that I may draw out some information on the subject. Having filled a box with lime properly prepared, and changed the purifiers so that they would be in sequence, after perhaps six hours' use the pressure would begin to rise, and it would continue to rise until it had reached twelve inches, at which point I have always considered it desirable to change boxes. I found we had to change so often that some other remedy must be found for the trouble besides using fresh lime and changing the purifiers. It occurred to me that it might be an accumulation of naphthaline crystals on the under side of the purifying surface; and, with that view, at a time when we had twelve inches pressure on the boxes, I opened the bye-pass to the exhauster, and speeded up the engine, so that the gas I was making in the retort house was not nearly sufficient to feed the exhauster, and then I drew the gas rapidly back from the purifiers. Great was my surprise to find that the pressure had gone down to six inches, and it remained there for about twelve hours. I thus got a partial remedy. I kept on repeating that—drawing the gas back rapidly from the purifiers, and breaking this seal on the under side of the lime. I have been unable to ascertain whether this crust is naphthaline, a coating of carbonate of lime, or something else. I would like very much to know what it is. I still use that method of freeing the purifiers, by opening the bye-pass, speeding up the engine and drawing the gas back.

Mr. Coggshall—I would like to ask Mr. Goodno what kind of coal he used in his experiment?

Mr. Goodno—In the record given in the table it was with Westmoreland coal.

Mr. Coggshall—I would like to ask Mr. Allyn how long he used the iron sponge when he had his trouble?

Mr. Allyn—In the trouble we have had this winter the sponge had not been used over six weeks or two months. In previous winters we have had it in sponge that had been in use for a year or more.

Mr. Coggshall—I had the same trouble this winter; but when I put in new sponge it was at once remedied.

Mr. Allyn—I had the same idea that Mr. Jones had—it was quite possible that the formation was of crystals of naphthaline—and so we introduced a large quantity of naphtha into the purifiers, but it had no effect whatever.

The President—Will Mr. Slater give us the benefit of his experience?

Mr. Slater—This winter I have been changing the purifiers very often—sometimes 2 or 3 times a day, according to the kinds of coal we were using; but we have had no other special trouble except the necessity of changing often. I think Mr. Goodno is right about rate of flow through the purifiers, and that the slower you pass gas through the purifiers, or in other words, the larger the purifiers are in proportion to the quantity of gas you are making, the better will be the work they will do. I think that is a well settled principle.

The President—I have been figuring my own rate of flow, and find that instead of 20 feet per hour, as he recommends, I was passing over 125, in purifiers 10 x 16, with a mixture of coal and water gas.

Mr. Coffin—This year we have trebled our boxes in size, and we purify more than double the amount per bushel. With 150 bushels of sponge and 30 bushels of lime we have passed 2,000,000 feet per purifier—and that is over 10,000 feet per bushel—but this was all Penn coal. We have had some different experience with the coals we have been obliged to use this winter.

The President—What was the rate of flow when getting 10,000 feet per bushel?

Mr. Coffin—Very slow; a good deal less than Mr. Goodno's statement.

Mr. Nettleton—We have had the same trouble at Derby with back pressure. It has been almost a chronic thing for several years. Two or three years ago we emptied and filled three purifiers in one day, in order to get rid of the pressure. If I followed Mr. Jones' rule of changing on 12-inch pressure I probably would not be able to make any gas at all, because, for several winters, we have not gone under 12 inches back pressure—the average pressure is from 14 to 16, and occasionally it runs up to 20. I mention this to show that it is possible to work under extremely high back pressure. It is unpleasant, but it can be done. To avoid this back pressure I mix planing chips with the lime, using one-half chips on bottom layer, and one-third or one-fourth on other layers. This is not a scientific method, nor do I consider it good practice, but it enables us to make gas, when otherwise with our small purifiers, it would be impossible to produce the quantity needed.

Mr. Allyn—To answer your question, Mr. President, partially, I will state the first experience we had with iron oxide at Cambridge. I laid

in a supply about the first of April. Of course in the first few changes we purified a very small quantity; but at each change the quantity purified per bushel increased, until we arrived at the time of our smallest consumption, when of course the gas was passing through at a very slow rate. In the month of July, when a large number of our heavy consumers are out of town, we purified 25,000 feet per bushel, without any change. At that time we were making about 75,000 feet per 24 hours. As the consumption increased the amount purified per bushel gradually fell off, so that when we reached our largest consumption—along about Christmas time, I think 450,000 or 500,000 feet—the amount purified per bushel dropped down to 5,000. At the commencement of the next season it began to increase as the consumption fell off, so that, when we arrived at the same season at which we had been purifying 25,000 feet the year before, we purified only about 12,000 feet per bushel. It plainly showed that the efficiency of the oxide depended greatly upon the rapidity or slowness with which gas is passed through the purifiers. Our purifying boxes are 20 feet square.

The President—How much material do you charge them with?

Mr. Allyn—Between 400 and 500 bushels.

Mr. Sherman—When we first introduced the manufacture of water gas by the cupola process one of the first snags encountered was this shell forming on the under layer of the lime. The same day after we turned it on to a box the pressure would go up to 20 inches. The remedy we applied, and the process which we are working to-day, is to pass the gas through a layer of sawdust before it comes to the lime. In that way we have no trouble from the formation of this shell. The shell was half an inch thick, and was perfectly impervious to the passage of gas. I would like to ask the members who are making water gas if they have had any of that experience, if they find that excessive back pressure comes by the passage of water gas through lime, and how they account for it? Mr. Slater is running on water gas exclusively; perhaps he will give us the benefit of his experience.

Mr. Slater—We have had no special trouble in that direction. We add 25 per cent. of breeze to the quantity of lime. We often ask the question—when we are told that Mr. So-and-So purifies 2,000 or 3,000 feet per bushel of lime, that another man purifies 10,000, and another 15,000—why it is so? It has seemed to me that with the same kind of coal, and under the same circumstances, and with about the same quality of lime used, there should not be much difference; but when we stop to think that some use purifiers six or eight times the capacity that others do, in proportion to the amount of gas they are making, we find an explanation. Of course, it also depends considerably upon the way the gas is treated before it reaches the purifiers; but I think the most essential thing is the capacity of the purifiers in proportion to the quantity of gas passed through them. I think Mr. Goodno brought this out in his paper, and that he is correct about it.

Mr. F. H. Parker—I tried to economize purifying material by using sawdust for the lower layers of the boxes, but found the first gas that passed through the sawdust will stain acetate of lead paper, but that after we removed the sawdust that disappeared. I would like to know if anyone has had that same experience.

The President—Before the discussion goes further I will ask Mr. N. W. Gifford to read his paper, as it is substantially on a subject similar to the one we are now discussing.

Mr. N. W. Gifford, of New Bedford, Mass., read the following on

TROUBLE IN PURIFYING GAS FROM SULPHUROUS COALS.

When one reads a paper before this Association, one is usually expected to have some interesting information to place before one's audience; but in the present case the facts are reversed, and I am looking for information. But I have lots of experience; and with the hope that a recital of some of my troubles may draw out the information from my hearers, which will be of value to me and perhaps interesting to some others, I have consented to appear before you in this role.

In order that you may see the condition of things in which my sulphur troubles found me, I will briefly sketch the arrangement of our purifying apparatus. The gas coming from the hydraulic, passes through 140 feet of 12 inch pipe before reaching the exhauster, then to the P. & A. condenser, on to the upright condensers, "Standard" washer-scrubber, and then to the purifying house. The boxes are 8 ft. by 13 ft., arranged in a square with seal in the center, and, judging from the rules laid down in the books, they should give sufficient capacity for our present make—about 160,000 cubic feet per day.

With other unfortunates, we found our coal contracts would not keep the town supplied with gas, and when our sheds contained only 18 hours' supply we were glad to have several small cargoes of Glace Bay coal come alongside. That was soon followed by some nondescript article, of which I can only say that it was not quite so bad as the first. Afterwards we received a load called Westmoreland.

I had never used any Eastern coal, but was not surprised to find foul gas coming from the last purifier. Our practice has been to change the boxes as soon as the gas at the outlet of second box shows stain on lead paper. By rapidly changing we were able to keep the third box clean and the second one nearly so.

We then felt quite comfortable, and began to think Scotia coal not so bad after all, leaving out the question of cost. But fate had decreed otherwise. The returns from the sulphur tests began to go up 20 grains, 30 grains, and I do not dare to say how much higher.

After a short run on two parts of Glace Bay to one part of the other coal we dropped down to equal quantities of each, but there was no relief. The gas showed no stain on lead paper, and even when left in a tube with gas passing all night, the paper was only slightly discolored in spots. It was difficult to believe that the gas was carrying off so much sulphur, and I looked for some fault in the testing, changed the water in the test meter, tried the reagents; but with no better results. I then placed a small purifier filled with clean lime just before the burner of the sulphur apparatus, but found as much sulphur as before. I then emptied the small purifier and refilled it with a layer of foul lime at the bottom and clean lime on top. The test of gas passing through this arrangement showed only a very small quantity of sulphur. Succeeding trials did not give such marked difference in amount of sulphur after clean lime alone or after foul lime in combination with clean. This may have been due to the foul lime becoming saturated with carbon-bisulphide. Still the average was considerably less after the foul lime.

I believe it is generally conceded that the sulphur in coal gas exists in the form of, first, hydrogen sulphide and, second, carbon-bisulphide, etc. The "etc." representing an indefinite number of compounds, but probably in small quantities. The system of keeping one foul box in the series seems to be based on the assumption that clean lime will absorb hydrogen sulphide, forming calcium sulphide, which will in turn absorb the carbon compounds. Now, is it not possible that the carbon-bisulphide may be in such excess of the hydrogen sulphide, that the supply of calcium sulphide may not be equal to the demand? I had suspected such a state of affairs and the above experiment seems to prove the theory.

The question then comes up, "Where has the hydrogen sulphide gone, or why this excess of carbon bisulphide?" This may be more easily asked than answered. The scrubber may be guilty of taking too much hydrogen sulphide if the liquor be kept too strong. But in this case I cannot believe my new "Standard" to be so mean, because the liquor has not been run up to a great strength. So the blame naturally falls back on the coal, which is mean enough for anything.

But if the coal is the cause of the trouble, why did the nuisance continue on a ten days' run with coal supposed to be quite free from the evil? Again, I do not know. One would hardly suppose the mains could be so loaded with the impurity as to contaminate the gas for so long a time. I have tried various ways of remedying the evil, but so far with poor success. I had more lime put into each box, but the only advantage was that it lasted longer. The first tier of trays was then covered with foul lime, while the others were filled with clean lime as usual, but thus far without success. This may have failed because of the foul lime being already saturated with sulphide of carbon as well as with sulphide of hydrogen. I thought the temperature of the purifying room might be too low and had the steam turned on, but the villain still pursued me.

Roughly speaking, the Provincial coal contained 5 per cent., and the other kinds 3 per cent., and some as low as 2 per cent. of sulphur. So you see the supply of sulphur is sufficient.

In conclusion, I would say as before, I have lots of experience, but would gladly swap some of it away for a little information.

Discussion.

The President—As Col. Benson has had considerable experience in purification, we would like to have him give us the benefit of it.

Col. Benson—While I may have had some little experience in purification, together with other parts of the business connected with the gas works under my charge, I am very happy to say I have not had such an unpleasant experience as has been related by some of your members. We have been using some Province coal, although not a very large percentage. At the time we commenced the use of Province coal we dropped our rate of purification from 5,500 feet per bushel of lime to 5,000 feet, and went along very comfortably. After that coal was used

up we resumed our 5,500 feet. Everything has gone along regularly, and we have had no difficulty in carrying that standard along. I may say that for two years we have been in the habit of changing our purifiers by the meter, in connection with experimenting for stains on acetate of lead paper at the outlet of the second purifier, so that when the meter indicates a certain number of cubic feet per bushel of lime a fresh box is turned on. Should anything else occur, outside of the regular system, it is noted by the fact that the paper will stain. I find that that is a more systematic way of doing business, rather than assuming at the end of a day that the box will run through a night, when perhaps it will not; but at any time during the night or day, if the meter indicates that the proper amount of gas has gone through, the boxes are changed. We have had no particular difficulty with the purification for the last two years. We did have serious difficulty three years ago—a difficulty which has not yet been fully explained, although the probabilities are that the carbonate of lime was formed in the first box, thus making a bad back pressure. It was at that time that we adopted this system of purification by meter, and since then we have had no trouble.

The President—Is there anyone present who has had the same or similar experience to that of Mr. Gifford?

Mr. W. A. Wood—I have had considerable experience with the Province coal, but cannot give any information. The experience we had was very similar, although not quite so bad. We were so situated that we had some Province coal, and used it in the proportion of two parts to three of the Pennsylvania coal. In using that proportion we changed as often as five boxes per day. The sponge that we were using, however, when the Province coal came in, was pretty well spent. We were purifying at the rate of about 2,100 cubic feet per bushel of sponge, but with the mixture I have stated the purification dropped to 700 feet per bushel. Since we have stopped using Province coal the purification has run back again to 1,800 feet.

Mr. Anderson—I have had some experience in being able to purify but very little to the bushel. I got some coal to which the shippers failed to give any name when they billed it to us, but simply called it "gas coal." It was a very fine looking coal—very much like the Youghiogheny—and with my old sponge, that we had been using a year, I have been able to purify about 500 feet per bushel. I discarded that after getting some new, and with the new sponge, which I have been running now for about a month, I am happy to say I can purify 1,000 feet per bushel.

Mr. Sherman—I had the same experience some years ago, at Worcester, in the purification of gas made from Province coal. We used to get generally at that time the Caledonia coal. I used it. Very suddenly there was a complaint all over town about the smell, and very luckily for us the people did not attribute it to the gas, but to the plumbers, who were working night and day in fixing leaky furnaces. As the Cambridge people were using the same quality of coal, I went to Dr. Howe for information, who said that he was using the same method of purification that we were, and that one of the Harvard professors who had examined the gas found in it 80 grains of bisulphide of carbon. I was not astonished that the plumbers were all busy in fixing the leaky furnaces. We got out of our trouble as soon as we got some other coal.

Mr. Taber—I have noticed from the reports of the members who have had trouble with lime, that they attribute this back pressure to a crust of carbonate of lime. I would like to ask Mr. Jones if he ever analyzed it, and, if so, whether he found it to be a simple carbonate, or whether it has anything to do with the ammonia compounds in gas as well. If it is simply the carbonate it might possibly be traced to the action of lime which had been improperly prepared, and perhaps not allowed to stand long enough to become a hydrate. If any one has made a chemical analysis of it we might get closer to solving the question.

Mr. E. C. Jones—I have never made a chemical analysis of the crust on the bottom of the box, but I have examined it microscopically. I have had it taken off very carefully, so as not to disturb the crust, and having found very beautiful crystals of naphthaline there, I was led to conclude that those crystals might act as a check in preventing the passage of gas.

Mr. Nettleton—I regret very much that I cannot add any accurate information to this discussion about sulphur. I am glad to see Mr. Gifford knows that his difficulties were due to sulphur in other forms than sulphureted hydrogen, but I am afraid that very many of us cannot say the same thing. Personally I have never felt like buying the expensive apparatus required to test for sulphur, and besides, have not had time to study the matter up. During the past winter we have been obliged to use poor coal; in fact, we have had to use any sort of coal that we could get, and much of it was wet. At times there has been an odor to the gas that was not absolutely free from sulphureted hydrogen. I have noticed it in my own house, and I have had some complaints come in. I don't intend to let matters go very much longer without knowing whether that odor comes from sulphur in the gas I manufacture or from some other cause. It seems to me a desirable move for us all to make—to ascertain if sulphur is in the gas other than is shown by the acetate of lead test.

Mr. Greenough—I think that the State Inspector of Massachusetts makes a great many tests of that kind; and that his tests show that ordinary American coal, purified in the ordinary way, will give about 12 to 14 grains of sulphur in other forms than sulphureted hydrogen in your gas. I think the Massachusetts standard is 20 grains (the English standard is 20 grains), and when we had our Massachusetts standard fixed, Mr. Hinman in various ways made strong efforts to get the amount reduced to 15 grains. He said there was no reason why it should not be reduced to 15 grains, because no one has more than 15 grains, and we might have the standard lowered. Objection was made that there was no use in making the change, and that we might as well adopt the English standard. I presume Mr. Gifford is familiar with the way in which the English companies remove their bisulphide. There is a good deal more sulphur in their coal than there is in ours, and they purify as well for carbonic acid. Their first set of purifiers is for the carbonic acid, the second for the bisulphide, the third for the sulphureted hydrogen. There are three sets of purifiers arranged one after the other. In endeavoring to do the whole thing as we do here, with one set of purifiers, we undoubtedly, in the first purifier, get some purification from the bisulphide, so long as we do not devote that first purifier to taking out the carbonic acid. Probably the best purification we could make would be to run the first purifier for carbonic acid, then run our second purifier for the bisulphides, and the third for the sulphureted hydrogen; but we are so afraid of the sulphureted hydrogen in the third purifier that everybody stops when the second purifier gets foul. It is easy for Mr. Goodno or Mr. Gifford to come here and propound questions, but it is another matter to answer them.

The President—Is there any gentleman present using lime exclusively, who can give us the difference in the amount of purification, between summer and winter, in the rate per bushel?

Mr. Rogers—We use lime exclusively. In the summer we purify from 7,000 to 8,000 feet per bushel, but in the winter we run down to about 5,000 feet.

Mr. Leach—That is about the case with us. We have about the same sized purifiers as they have at Jamaica Plains.

Mr. Sherman—While we are on this subject I would like to introduce an old chestnut here in the shape of the question whether it is profitable to use iron purification. I have made no figures with regard to it for some time; but since the advent of cheap enrichers in the shape of Lima oil I think we will have to revise our figures. I have been of the opinion that we could not afford to use iron when we could get lime as cheaply as we can in our place, and that we could not afford to make up the additional candle power which we lose by using iron purfication.

Mr. Lamson—What does your purification cost?

Mr. Sherman—Under the abnormal conditions which prevailed this year it was 1½ cents. As to the addition of cannel coal, it is out of the question; for if you have to use cannel coal you cannot afford to use iron. With Lima oil I suppose we would have to revise our figures in that direction.

Mr. Anderson—I will state, with regard to the difference between the cost of lime and sponge, that, in my case, the lime costs about 30 cents per bushel, while I can make 100 bushels of sponge at a cost, including labor and material, of $15, run me for over a year.

Mr. President—It has been suggested to me that Mr. Shelton is posted on this subject. Will he give us the benefit of his experience?

Mr. Shelton—I am very much obliged to the gentleman for putting it in such a complimentary manner. The only thing about it is that it is not so. I would like to be very much posted on the subject. I think that is what we are all here for. Of course I am connected with a company which uses a great deal of oxide of iron, and lime; but as to which we prefer, that is perhaps one of the questions which has been suggested, I can only say we are steadily getting away from lime, especially in the larger works. It may be a question as to the disposition of the spent lime, and it may be a question of labor. The fact is that in all the works we are interested in throughout the country, we are, as I say, steadily decreasing the use of lime, and are more and more coming to the use of oxide of iron. As to the amount purified per bushel, it is hard to lay down any fixed rule that will apply to different works. The size of the boxes, the rate of making, the kind of oil used, the system of manufacture, and a dozen different factors, come in to complicate the question so that no rule can be laid down. And while all of us have a little knowl-

edge on the subject, and a few figures in mind, I would not dare to give any figures off-hand that I would have confidence in as being safe to go by. It is like two ships, that, being built on the same model, yet might work very differently. We have each to work out our own rule of action in each of our works.

Mr. Greenough—I do not believe there is practically any such difference in candle power between gases purified by oxide and purified by lime as there appears to be theoretically. If you should take a gas and inject 2 per cent. of carbonic acid into it, it would undoubtedly deteriorate its illuminating power more than 2 per cent; but if from an unpurified gas you undertook to take that 2 per cent of carbonic acid, you are taking away something which will not give illuminating power. At the same time when you take two works, one of which purifies by oxide and the other purifies by lime, you do not find in practice that it is necessary to use any appreciable amount more of enricher in one place to reach a certain candle power than in the other; and you find that your theory to a certain extent is not borne out by the facts. But when your purification costs you in the one case over 2 cents per 1,000, and in the other case but one cent, then I think you will find that the oxide is the cheaper of the two.

Mr. Lamson—I do not know that it is generally understood here that there is a proposition now under consideration by the State Inspector to have gas tested by the flat-flame burner instead of by the Argand. He argues that he has put that in on the ground that the general public use the flat-flame burner instead of the Argand burner. I went back on the argument to the old ground that gas ought to be tested absolutely; that if there were so many candles in gas, we should have the benefit of it; and that in testing we should use a burner which would give that value. We had quite a discussion over it. I understand that the recommendation is in his report. In fact, he told me it was. His argument was, I believe, largely that the gas at Cottage City gave very fair candle power (something over 16 candles) by testing with an Argand burner, but that when it was burned with a flat-flame burner it was very bad indeed. That stirred him up, and he proposes to have the law changed so as to test gas by a flat-flame burner.

The President—I remember that several years ago Mr. Blodgett made some experiments with lime and oxide purification. I will ask him to give us the benefit of those experiments, and of others if he has made any since.

Mr. Blodgett—I do not know how fully you want me to go over the ground. I can only say that in the result, as to illuminating power, they were fully equal, one as against the other. The gas purified by lime was no higher, and no lower in candle power than that which was purified with oxide of iron. The carbonic acid was a little over 2 per cent.

Mr. Lamson—The State Inspector claims that a gas that has a considerable amount of carbonic acid in it shows to a greater disadvantage in a test with a flat flame burner than it does with an argand burner.

Mr. Anderson—I will state from actual knowledge that I have tried, wholly, oxide, and I was unable to make gas under the same conditions which would stand higher than 17.5 by a Jones jet photometer; but when I added one tray of lime to each box my candle power stood at 18.3 right along.

The President—That would be the case with a photometer that owed its registering value to the gravity of the gas. With all due respect to Mr. Jones and his photometer that was no test of the difference.

Mr. Sherman—The Manhattan Company, of New York, tested their gas with the flat flame empire burner for years, on the ground that they got better candle power from that than they did from an Argand burner.

Mr. Jones—I remember Mr. Pratt saying, when visiting him at the Municipal works in New York some years ago, that he got better results from the flat flame burner in testing water gas. I would like to ask, supposing the Welsbach burner became the consumer's burner in the future, and the flat flame burner should go out of use, would Mr. Hinman recommend the Welsbach burner as the standard test of illuminating power, and giving us, perhaps, 50 candle gas?

Mr. Nettleton—We have had two very practical and interesting papers, and I move the thanks of the Association be tendered to Mr. Goodno and Mr. Gifford for their papers. (Carried.)

ROLL CALL.

Upon the call of the roll the following members answered to their names as being present:

Honorary Members.

Joseph R. Thomas, New York, N.Y. Col. Fred. S. Benson, B'klyn, N.Y.
Eugene Vanderpool, Newark, N. J.

Active Members.

Africa, W. G., Manchester, N. H.	Macmun, G. F., Natick, Mass.
Allyn, H. A., Cambridge, Mass.	Manchester, G. L., Easthampton, Mass.
Amory, Dr. R., Boston, Mass.	
Anderson, W., Marlboro, Mass.	McNeil, N. J., Boston, Mass.
Andrew, J., Chelsea, Mass.	Moore, D., Salem, Mass.
Anthony, A. C., Providence, R. I.	Neal, G. B., Charlestown, Mass.
Atwood, H. A., Plymouth, Mass.	Nettleton, C. H., Birmingham, Conn.
Badger, W., Concord, N. H.	
Bigelow, H. N., Clinton, Mass.	Norton, A. M., Nashua, N. H.
Bill, G. D., Malden, Mass.	Norton, F. W., Nashua, N. H.
Blood, F. C., Ware, Mass.	Norton, H. A., Boston, Mass.
Boynton, D., Chicopee, Mass.	Parker, A. H., Bangor, Me.
Burnham, J. H., East Boston, Mass.	Parker, F. H., Burlington, Vt.
Coffin, J. A., Gloucester, Mass.	Perry, A. D., Boston, Mass.
Coggshall, H. F., Fitchburg, Mass.	Prichard, C. F., Lynn, Mass.
Cooper, A. F., Exeter, N. H.	Quinn, A. K., Newport, R. I.
Coyle, P., Charlestown, Mass.	Richardson, F. S., N. Adams, Mass.
Crafts, D.W., Northampton, Mass.	Rogers, J. F., Boston, Mass.
Davis, F. R., Athol, Mass.	Rossman, G. M., Keene, N. H.
Fowler, S. J., Springfield, Mass.	Sanborn, W. T., Dover, N. H.
Gerould, L. P., Brooklyn, N. Y.	Saville, L. A., Lexington, Mass.
Gillmor, O., Norwich, Conn.	Sherman, F. C., New Haven, Conn.
Goodno, G. F., Dedham, Mass.	Slater, A. B., Providence, R. I.
Greenough, M. S., Boston, Mass.	Spaulding, C. F., Waltham, Mass.
Harbison, J. P., Hartford, Conn.	Spaulding, C. S., Brookline, Mass.
Horton, A. J., Brattleboro, Vt.	Spaulding, W. H., Clinton, Mass.
Jenks, Z. M., Woonsocket, R. I.	Stiness, S. G., Pawtucket, R. I.
Jewitt, M., Clinton, Mass.	Stratton, W. K., Haverhill, Mass.
Jones, E. C., Boston, Mass.	Taber, R. B., Boston, Mass.
Kelly, H. H., Waltham, Mass.	Tarbell, A. W., Waltham, Mass.
Lamson, C. D., Worcester, Mass.	Tarbell, W., Waltham, Mass.
Lane, F. H., Wallingford, Conn.	Tilton, D. D., Newburyport, Mass.
Lane, H. M., Leominster, Mass.	Todd, J. R., Middletown, N. Y.
Leach, H. B., Taunton, Mass.	Warren, C. F., Manchester, N. H.
Learned, E. C., New Britain, Conn.	Wetherbee, G. E., Worcester, Mass.
Learned, W. A., Newton, Mass.	Wood, W. A., Dorchester, Mass.
Long, R. J., Salem, Mass.	Yorke, E. H., Brockton, Mass.

Associate Members.

Coburn, C. M., Chelsea, Mass.	Homes, W., Boston, Mass.
Davis, F. J., Waltham, Mass.	Smith, R. R., New Hartford, Conn.
Fairbanks, F. P., Holyoke, Mass.	Tobey, F., Jr., Rondout, N. Y.
Gifford, N.W., New Bedford, Mass.	Waldo, J. A., Boston, Mass.
Hicks, G. C., South Boston, Mass.	

The Association took a recess until 2:30 P.M.

(To be continued.)

[Continued from page 260.]

The Chicago International Exhibition of 1893.

[A paper read by Mr. James Dredge, of *Engineering*, before the British Society of Arts.]

The object of this paper is only to give some idea of the nature and scope of the coming Exhibition at Chicago, and of the more interesting characteristics and importance of the city in which it is to be held; but it has been by no means the intention to urge the manufacturers of this country to assist in making it an International Exhibition. It would be, without doubt, freely admitted in the United States that it depends on the action of England whether the undertaking will have to be confined within national limits, or whether it will be aided largely by foreign co-operation. A month ago the universal feeling in Europe was one of resentment against a country that decided, as it seemed wantonly, to close its ports to foreign trade; at present it is one of amazement at the spectacle of a nation that has risen to denounce its lawmakers and to sweep them from the Capitol. But the result of the political cyclone that has devastated the Republican Congress remains yet to been seen, and it must not be hastily assumed that a reaction in favor of free trade has set in; the most that can be expected is that the effort to exaggerate protection, and to benefit Eastern manufacturers at the expense of Western agriculturists, has been defeated, and that foreigners will continue to find American markets as heretofore. If this should prove to be the outcome of the recent elections, there can be no doubt that the value of these markets to this country will continue to increase rapidly from year to year with the growth in the population and the wealth of the Western States. If it be assumed—and such an

assumption appears reasonable—that the voice of the United States has been raised in a successful protest against any increased protection, English manufacturers will be able to judge for themselves how far the expense and trouble of exhibiting will be a justifiable speculation, and, in coming to a conclusion on this point, they should bear in mind that the Exhibition will be held in the great purchasing center of that section of the continent where the sentiment in favor of reduced tariffs is the strongest. In this place it may be worth while to call attention to a curious though natural result of the McKinley Bill. In anticipation of this obnoxious measure becoming law, American buyers had been for months before purchasing in the European markets on an enormous scale, and at the present time vast stocks have been accumulated, bought under the old tariff. The natural result of this, combined with the social revolution that appears to be at present taking place, but the results of which can have little commercial consequences for many months to come, will increase the stagnation of American foreign trade, since existing stocks will be drawn upon to the utmost, and further purchases delayed as long as possible, in the hope that, before they are exhausted, reasonable counsels will prevail, and disturbed commercial relations readjusted. In such a fortunate event the clogged channels of European trade with America would be cleared, and the volume of foreign commerce westward would be vastly increased. Should this desirable result be achieved within the next eighteen months, it is probable that the Chicago Exhibition will be an international one in a broad sense of the term. But if time bring about a different solution than now appears probable, even should the McKinley Bill be sustained, with all its evil consequences at home and the paralysis of American foreign trade, there would still remain certain branches of English history and art that would distinctly be benefited by being represented at the Chicago Exhibition. In the first place, it must not be forgotten that at these vast gatherings foreign buyers come in crowds, and should Europe abstain from participation, new and valuable business connections will be secured to America that English manufacturers might have obtained; or still worse, existing customers may, and probably will, be taken from us if we are not there to look after our proper interests. Even with prohibitory tariffs, there are certain branches of industry that will continue to command American purchasers. For instance, no amount of protective legislation will enable the United States to approach this country in many departments of art industry. In saying this it must not be forgotten that America has created her own school, but at present the products of that school do not compete. In stained glass, the art products of the loom, in ceramics, high-class furniture, fine table and decorated glass, and in many other arts, this country will continue to hold her own for years to come, and to be the source from which American demands will be supplied; that these demands will continue to increase is practically certain, considering the abundance of money in the United States, and the increasing taste for articles of luxury, which is gratified with considerable liberality. In this connection, too, it may be well to remember that the number of Americans visiting Europe augments from year to year—during the season just closed, the total number that crossed the Atlantic was greater than that which flocked over last year to visit the Paris Exhibition—and that London is rapidly and surely becoming a greater favorite with Americans as a place to visit, and especially as a place in which to purchase, than Paris. The number of American visitors is estimated at from 80,000 to 100,000 annually, and each of them leaves behind him in Europe at least £50; so that some four or five millions sterling—a large proportion of which is spent in purchases—is added to the wealth of Europe every year. On this account, it is reasonable to suppose that English manufacturers who take the risk of exhibiting at Chicago will form lasting and valuable business connections with Americans who take advantage of their frequent visits to this country to make extensive purchases, which they are able to pass into the United States as personal effects, and therefore free from duty. It should be mentioned that it is the intention of the Exhibition executive to establish, as a part of the undertaking, a vast bazaar, where articles which are shown as samples in the Exhibition buildings can be purchased. Considerable benefit is likely to arise from this arrangement, for everyone knows how the purchasing inclinations of visitors are checked by inability to procure and carry with them objects which may attract their fancy when visiting an Exhibition. Before the time for closing has arrived, the desire for possession has passed, and many valuable, even though transient customers are lost. It is thus evident that there exist some strong and sufficient reasons for manufacturers to exhibit, even though they have to do so under the disadvantages of a heavy tariff.

But there are other classes of industrials to whom the benefits to be derived from exhibiting are not doubtful. For example, the inventors of machines or processes for which United States patents are held, and which it is desirous to sell, will certainly find the Exhibition a convenient means of drawing the widest public attention to their inventions. English manufacturers, too, who have been forced, under the pressure of prohibitive duties, to establish factories in the United States in order that they may maintain their trade, will obviously find it to their advantage to appear in the English as well as in the American section, in order to impress upon the mass of visitors, who may be also their customers, that the articles they produce in the American factories are identical with those made in their works at home. In like manner, manufacturers who are hesitating about establishing such branch works in America will be able to form a clear idea of the advisability of such a step, by exhibiting the goods they would propose to manufacture for the criticism and approval of visitors; the outlay and trouble would of course be considerable, but the public verdict they would secure would serve as an excellent guide to them for pursuing or abandoning their project. It would not be difficult to find other illustrations to strengthen the assertion that the Chicago Exhibition of 1893 may be used by many of our manufacturers for their distinct benefit. The industrial sections of an international exhibition are nothing more nor less than a costly form of advertisement, and, like every other class of advertising, the most important results that follow are indirect. But just as it is useless to advertise in any medium where the goods announced have no interest for the readers, so it is clear that the Chicago Exhibition will be of no service to many classes of manufacturers in this country. Exhibitors of agricultural machinery, of mining plant, of railway machinery (except, perhaps, signaling apparatus), of labor-saving devices, of educational exhibits, and many others, would be absolutely thrown away, unless with very rare exceptions, so far as any commercial benefit to the exhibitor is concerned.

As regards the Art Section of the Exhibition, two distinct questions would arise; the first having reference to an art collection worthy of this country, and consisting chiefly of pictures lent for the occasion. Such a course was followed at the Philadelphia Exhibition of 1876 with very satisfactory results; it is obvious that this class of collective exhibit has no reference whatever to commerce, and can only be carried out at a very heavy cost, which may be justified by the desirability of maintaining the credit of British art abroad. The other class of art exhibits has a more commercial object; there are many painters of excellence in this country who find it difficult to obtain and keep so large a number of clients as they desire, and these would undoubtedly find new purchasers in America in spite of the heavy tariffs imposed on paintings. Such an exhibit certainly may not be a representative one, but it would doubtless have the advantage of bringing to many struggling artists in this country a rich and liberal *clientele*.

Whatever objections there might be to the creation of a British Section in the Chicago Exhibition, there cannot possibly be two opinions about the advantages which would accrue to visitors from this country. Comparatively few Englishmen have any idea of the wealth and resources of the United States; of the progress and culture of its people in remote regions; of the part which America is destined to take in the near future in the civilization and commerce of the world.

The Columbian Exhibition will indicate how far America has advanced in industry and invention; a visit to those sections of the United States of which Chicago is the metropolis will give an idea, such as cannot be conveyed by any amount of statistics, of the resources of the country and the rate at which they are being developed by an energetic people. Except in some few branches of industry, the manufactures of the United States have not come into contact with our own in foreign markets; the fostering influences of protection, and the ever-increasing demands of a vast and rapidly growing population, have kept manufacturers busy in supplying home wants. But the time will come—and if a reduction of tariff should be one of the results of the accession of the Democratic party to power, the time will come quickly—when American industry will be stimulated into fierce competition with our own abroad, and our manufacturers will have to enter upon a struggle for supremacy, the severity of which it is impossible to predict. For this reason, to say nothing of the interesting experiences that can be gained, every Englishman who can spare the time and money, should look forward to visiting Chicago in 1893.

Such a visit should, however, be undertaken with the object of work, and not of amusement; neither Chicago, and as a matter of fact, no other American city, possesses any of the attractions that Paris offers, but what is lost in pleasure is compensated for by instruction. The recommendations given above apply therefore only to those who wish to gain valuable information by hard work. As to the cost of such a visit,

it may be said generally that, apart from the expense of traveling, and if the executive committee succeed in completing their arrangements with the hotel keepers in Chicago, the expense will probably be less than that of a visit to the Paris Exhibition last year. Exhibitors, of course, would have to be prepared to face a larger expenditure; however favorable the arrangements may be for the transport of goods, the long distance that has to be overcome will be costly; labor, too, commands higher prices than in this country, so that on the whole the cost of exhibiting in Chicago will be greater than that in Paris. Should the Government see fit to appoint a Royal Commission endowed with funds, it is evident that exhibitors will be relieved to a considerable extent, as no charge will be made for space by the Exhibition authorities, who will, moreover, extend to foreign sections the greatest possible liberality as regards the supply of power, lighting, guardianship, local transport, etc.

Whether the Chicago Exhibition of 1893 is to be in reality as well as in name a World's Fair, or the commercial relations of the United States with Europe are such as of necessity to restrict its scope chiefly to the display of National industries and arts, it is evident that the undertaking will be full of the greatest interest to the thoughtful foreign visitor, and a profit to not a few British manufacturers.

Some Census Figures on the Coal Industry.

The following figures respecting the coal production of Maryland and Alabama are from the bulletins prepared by Mr. John H. Jones, Special Agent of the Census Bureau:

The shipments of coal, in long tons, from the Georges Creek or Cumberland region of Maryland from 1870 to 1889, inclusive, have been as follows:

1870	1,628,052	1881	1,960,016
1871	2,167,482	1882	1,272,122
1872	2,148,766	1883	1,891,495
1873	2,492,726	1884	2,453,810
1874	2,254,199	1885	2,386,887
1875	2,188,436	1886	2,152,713
1876	1,718,853	1887	2,811,883
1877	1,574,339	1888	2,934,907
1878	1,688,324	1889	2,510,478
1879	1,730,658		
1880	2,069,587	Total	42,035,733

Coal Production of Maryland in 1889.

Counties.	No of Mines.	Total Product. Short Tons.	Shipped by Rail or Boat. Short Tons.	Used by Local Trade. Short Tons.	Used at Mines. Short Tons.	Value of Total Product at Mines.
Allegheny—Regular estab'ts.	30	2,931,947	2,885,114	36,684	10,149	$2,508,786
Local mines	11	3,134	.....	3,134	.....	3,817
Garrett—Regular establishm'ts and local mines	39	4,634	222	4,412	.....	4,861
Total	80	2,939,715	2,885,336	44,230	10,149	$2,517,474

Alabama.

The following table shows the number of mines and the total production in short tons of coal in Alabama, by counties, together with the total value and average price per ton at the mines in 1889:

Counties.	Total Product.	Loaded at mines for shipment on cars or boats.	Used by employees and sold to local trade.	Used for steam and heat at mines.	Made into coke.	Value of the total product at mines.	Av. price per ton.
Tuscaloosa	16,141	8,600	6,991	550	.....	19,796	1.23
Jefferson	2,305,383	1,399,244	39,577	42,208	824,354	2,485,744	1.08
Walker	460,254	452,274	3,950	4,030	.....	474,956	1.03
Etowah, Blount, Cullman, Cherokee	5,255	.....	5,255	.....	.....	9,278	1.77
Bibb	500,525	363,102	1,414	17,590	118,419	604,230	1.21
Shelby and St. Clair	90,926	43,619	1,497	6,312	39,498	113,422	1.25
Total	3,378,484	2,266,839	58,684	70,690	982,271	$3,707,426	$1.10

Of the amount shown above as loaded at mines for shipment, 1,868,596 short tons were delivered for consumption within the State of Alabama. The total number of regular establishments was 44; of small banks and local mines, 22. Of the former, 19 were in Jefferson county, 10 in Bibb, 8 in Walker, 4 in Shelby and St. Clair, and 3 in Tuscaloosa.

The coal fields of Alabama form the southern extremity of the great Appalachian coal fields, the northern limit of which lies along the western New York and Pennsylvania State line, which extend southwestward to Tennessee, Alabama, and Georgia. The State Geological Survey of Alabama estimates that the coal deposits of this State embrace an area of 8,660 square miles, although actual mining operations are conducted in but ten counties—viz., Blount, Cherokee, Tuscaloosa, Jefferson, Etowah, Saint Clair, Bibb, Shelby, Walker, and Cullman. This region is divided into three distinct districts. That portion drained by the Warrior river and its tributaries and the Tennessee river and its tributaries, in Alabama, constitutes the Warrior coal field. The Coosa field is situated in Saint Clair and Shelby counties, and is drained by the Coosa river. The Cahaba field lies along the Cahaba river in the counties of Shelby, Jefferson, and Tuscaloosa.

The coals of Alabama embrace all the bituminous varieties, such as gas, coking, block, splint, and cannel, thereby providing the rapidly developing industries and increasing population of the State with an inexhaustible supply of fuel for furnace, steam, and domestic uses.

Mining of coal was begun in this State about the year 1853, but the total output, which was produced mainly by small operators for local consumption, did not reach 100,000 tons until the year 1876. The production for the census year 1880 was 323,972 tons, valued at $476,911 at the mines. The growth of the industry thenceforward has been almost phenomenal, the product for the calendar year 1889 being 3,378,484 tons, valued at $3,707,426. The average number of persons employed during the year, including superintendents, engineers, mechanics, and clerical force, was 6,762, and the amount of wages paid was $3,175,356. The figures above given apply exclusively to the mining of coal and preparing it for shipment, all expenditures for the manufacture and handling of coke being excluded. The average number of days when mines were shipping coal was 196 during the year 1889.

The following lines of railroad traverse the coal fields of Alabama, and provide facilities for the transportation of the products: Alabama Great Southern Railroad; Louisville and Nashville Railroad; Kansas City, Memphis and Birmingham Railroad; Kansas City, Fort Scott and Memphis Railroad; Georgia Pacific Railway; Nashville, Chattanooga and St. Louis Railroad; East Tennessee, Virginia and Georgia Railroad; East and West Railroad of Alabama; Cahaba Coal Mining Railroad.

Laying Water Pipes Across Rivers.

At an adjourned meeting of the New England Water Works Association (held at Boston on the 11th inst.), Mr. Gowing read a paper on the best means of laying water pipes across a river, whether on the bed of the river or across a bridge, referring to some 8-inch pipe laid under water at Skowhegan, Me., under his direction.

Mr. Holden, Superintendent, Nashua, N. H., spoke of some 700 feet of pipe which he was going to lay across the Merrimac river. He proposed to carry this over a bridge, and to use wrought iron or steel pipe.

Phinehas Ball, of Worcester, Mass., gave an account of laying certain water mains for the Springfield, Mass., water works in 1874. It was necessary to cross the Chicopee river at a point where there was a rapid fall. On either side an abutment was built, making a span of 173 feet. Two 24-inch mains were made of ⅜-inch boiler iron riveted together, and placed in position so as to form the upper chords of a bridge between the abutments. These pipes had expansion joints at each end. Water was let in during the latter part of December, 1874, and although the pipes were without any covering whatever, no trouble was experienced from freezing. Another similar case, at New Haven, Conn., was referred to, where, although the pipes were suspended under the bridge, they were entirely independent of it. At Greenfield, Mass., a number of years ago, some 8-in. pipe was laid down a ravine or narrow gorge, partly on the rocks and partly on iron supports, and, although in use for six or seven years, and exposed to the weather without any covering, there was said to have never been any trouble from freezing. In such cases, and those under consideration, Mr. Ball recommended wrought iron or steel pipe.

In the discussion Dexter Brackett said that whether a pipe should be laid under or over a stream depended on the temperature to be met with. Referring to a 16-inch pipe supplying the whole town of Everett a few

years ago he said that it was frozen solid, although for several years it had given no trouble. This pipe was not boxed in. To prevent freezing, Mr. Brackett thought that more dependence could be placed on a tight air space than on boxes filled with sawdust or similar material. In certain cases he had double-boxed the pipes and filled in the space between the boxes with coal tar asphalt so as to make an air-tight covering for the pipes themselves. In considering the question of a pipe over or under a stream, it should be remembered that the pipe over the stream is more accessible to the superintendent in determining leaks, etc. Mr. Jones, ex-Superintendent Boston water works, referred to the severity of the winter of 1875, when the city had 10 or 15 streets opened to take care of frozen water pipes. During that winter 5,000 feet of service pipes were frozen. Of this length 2,000 feet could not be reached until the spring.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, Feb. 10, 1891.

The Destruction of Two Gasholders at Glasgow.—The Gas Light and Coke Company.

One of the most remarkable occurrences on record, in connection with gasholders, took place at Glasgow on the 15th ult. The gas undertaking of this important city is the property of the municipal authorities, and comprises three different stations. The one in question, known as Dawsholm, is situated in a somewhat isolated position outside the town, and includes three gasholders arranged in line, about 25 feet apart, but fortunately, as it turns out, at some little distance from the rest of the buildings and plant. The three gasholders are all similar in respect to diameter, being 160 feet across. Two of these have lately been enlarged by the addition of a third lift, which made them 90 feet in height, and equal to containing more than 1,500,000 cubic feet of gas each. The third remained a double lift, consequently about 60 feet high and holding something over 1,000,000 cubic feet of gas when full.

At about 4:30 in the afternoon the outlet valve of No. 1 was open for the supply of the district, No. 2 shut off, and the inlet of No. 3 was open to receive the make of gas. The valve man, McAlister, opened the inlet of No. 2, with a view, apparently, of diverting the make from No. 3. At this time No. 1 was three parts or more full, No. 2 a little less, but sufficient to cup the lower lift, and No. 3 was not far from being full. Before McAlister could complete his purpose by closing No. 3 inlet, a large mass of flame was observed shooting high into the air, over the roof of No. 2, the center holder. It was accompanied by a loud rumbling noise like the shock of an earthquake, together with a concussion that caused windows to rattle violently, and greatly alarmed the inhabitants of the neighboring part of the town. This appears to have been caused by the bursting of the roof of the gasholder in all parts. It was quickly followed by the destruction, with a second concussion, of No. 1 holder, and in a few minutes the whole structure of both holders lay in a confused mass at the bottom of the tanks. Fortunately this was unattended with loss of life or even serious injury. Workmen who happened to be in the vicinity were scorched, and some haystacks 100 yards off were set on fire; but the enormous volume of some 3,000,000 cubic feet of gas appears to have passed steadily up into the air, and burnt away as fast as it could meet with sufficient oxygen to support combustion. The whole affair was over in four or five minutes.

Mr. Wilson, the Superintendent of the works, was in his office at the time. He made his way to the scene at once, and as soon as the nature of the affair was apparent had the valves for No. 1 and No. 2 holders closed, and maintained the supply of the district from No. 3. So that, although the destruction of No. 1 caused a complete stoppage of the supply, it was resumed in a few minutes. The effects that might have followed in this direction were greatly mitigated by the fact that the mains supplied from the works are also connected up to other stations.

The fact that no one was injured by being thrown violently to the ground, and that no injury either to life or property, by the falling of scattered debris, is recorded, seems to show that there was no explosion of gas. Portions of the roofs of the holders appear to have been thrown as high as the top of the framing, as shown by the fact that some fragments were found entangled at that part; but I do not gather that any were "scattered" considerably beyond the plan of the tanks. Had any portions of the retort houses, purifier houses, etc., received substantial injury, the results might have been very serious. Even the guide framing remains almost intact though considerably bruised and torn. The damage is estimated at about £5,000, and is to be repaired at once.

The Corporation have had a careful inquiry into the circumstances, conducted by Mr. George Livesey, Mr. Chas. Hunt, an expert on gasholder construction, and an authority on explosives. These four gentlemen have presented a very brief report, stating that they are satisfied that the holders did not contain any explosive mixture, nor did they possess structural defects. But there were "indications of an explosive material having been placed on the crown of No. 2." The explosive power, striking inward, ruptured No. 2, and the concussion was considered sufficient to account for the damage to No. 1. The "indications" appear to be an irregular fracture, having the edges bent *inward*, and corroded as if by the action of chemicals.

The extremely brief and guarded nature of this report, which evidently does not aim at publishing full details of the circumstances, together with the fact that the Corporation have offered a reward of £1,000 for the apprehension of the author of the catastrophe, have naturally created some public excitement. This has also been stimulated by the fact that the Government Inspectors, who have made an independent inquiry into the matter, have not yet reported upon the subject, and that one of them is carefully collecting evidence from eye-witnesses. Possibly it will subsequently turn out that the full particulars should not be published in the interest of justice at present, but unless further information is forthcoming, a great deal of doubt will prevail as to the exact cause. Already the "explosive" theory is called in question by the suggestion that the fracture with edges curved inward was caused by a fragment from the neighboring holder. The absence of any sharp report or detonation like that usually attending the firing of dynamite is also mentioned. Looking at the number of gas holders in use, many of which are situated in the midst of populated districts, it is most desirable that the matter should be thoroughly cleared up and that not the slightest ground should remain for the least suspicion of anything in the way of "spontaneous combustion." A considerable section of the public have always regarded gasholders with great suspicion. The member of Parliament who, in the days when gas lighting first became general, suggested that gasholders should be confined within "explosion-proof" buildings, would find some supporters if he brought forward his proposition in these days.

The affairs of the Gas Light and Coke Company have attracted a considerable amount of attention since the publication of their accounts for the second half of 1890, a week or two ago. They have suffered heavily from the increased price of coal, the cost of which has risen from about £554,000—the figure at which it stood for the corresponding period of 1889—to £789,000, an increase equal to something like 6d. per 1,000 cubic feet of gas sold. This is unaccompanied by any important increase in sale of gas, the output only amounting to a small percentage over that in 1889, and therefore it represents with tolerable accuracy the increased price paid for the coal. All gas companies have had to pay more for coal lately, yet but few of them have been so unfortunate as to experience such a rise as that above indicated. This coal item has been subjected to very sharp criticism, some alleging that it has been increased by "bad buying" and by accepting contracts at prices that are not the lowest attainable. Wages and repairs between them have cost £50,000 in excess of last year, so that altogether, with other matters, there is an increased expenditure of over £300,000 to provide for. Something more than half of this has been met by an increase in the price of gas, and there is also some improvement in the matter of residuals. Fortunately there is a substantial reserve fund on hand, and this will have to be resorted to to the extent of nearly £150,000, in order to make up the usual profits for the shareholders. No wonder, then, that some of the latter body have taken fright, and are pointing out that at this rate the reserve fund will be exhausted in a year or two. They say that unless the price of gas is raised shareholders' profits will be largely reduced. Then there is an objection to raising the price as likely to drive away customers. The electric light companies are now firmly established in London, and are prepared to avail themselves of every opportunity that offers for increase of business. Although the price at which they supply electricity (8d. per unit) is equivalent to about 8s. per 1,000 cubic feet for gas, they have not yet been able to pay any dividends; and so it is only to be supposed that they are keenly on the lookout for any means of increasing their revenues, and any increase in the price of gas would doubtless be used as a lever to this end. I have on previous occasions referred to the remarkable character of the figures published by this Company, as shown by comparing one half year with another, and therefore venture to think that they will manage to pull through without further increase of price. After meeting the present deficit, a balance of nearly £400,000 will remain to the credit of the reserve fund. Residuals are certainly improving. The coal is bought by contract, and will therefore probably remain at its present figure for the first half of the present year. But there are already indications of

better times for gas companies in this respect. Coal merchants are anxious to secure forward contracts, and probably prices will be easier during the coming summer.

It is somewhat surprising that the Gas Light and Coke Company does not appear to have shared so largely in the increased demand for gas, experienced throughout the whole of last December, on account of the unusually cold and dark weather, as most provincial companies. They have lately developed the business of letting out not only gas cooking stoves, but also heating stoves, on hire, and London has always been noted for a heavy consumption in times of frosty weather. In some towns an increase of over 20 per cent. for the month alone, or 8 to 10 per cent. for the half year, has been recorded. This increase, by the way, has continued throughout the month of January. So that not only have last half-year's accounts received some impetus, but the advantage has been continued to the current one.

Estimating the Value of Purifying Materials.

It is a well-know fact that an analysis of a gas purifying material is not a fair criterion of its value. Besides the composition of the material, the following factors require to be taken into consideration, namely, (1) weight, (2) size of grain, (3) moisture, (4) the substance used for rendering the mass more permeable, (5) the depth of the layers, (6) and (7) the velocity and difference in pressure of the gases previous to entering and after leaving the purifier. E. Schilling in the *Journal fur Gasbeleuchtung* has been describing the best method in his opinion for ascertaining the value of a purifying material. A current of pure sulphureted hydrogen was passed over the substance finely powdered, retaining the water which was produced by phosphoric anhydride. Even after passing the current for 20 hours complete saturation was not effected. Most of the action was over in three hours. Pure ferric hydroxide absorbs on an average after the first saturation 30.77 of sulphur ; different varieties of bog-iron ore from 11.2 to 28.41 ; the theoretical amount of sulphur corresponding to the amount of iron oxide present varied from 18.06 to 42.69. From this it will be seen that in no case, not even that of pure ferric hydroxide was the maximum absorption equal to that theoretically possible. And it does not appear that there is any relation between the amount of iron in the material and the amount of sulphur absorbed. If wood shavings are mingled with the absorbing mass, the quantity of sulphur absorbed is greatly increased ; this simple and inexpensive plan ought to be at once adopted, as the presence of sulphur in gas is an exceedingly troublesome occurrence.

The Direct Production of Light.

In a paper contributed to *Ravisti Maritima*, Signor Giulio Bertolini gives a summary of the remarkable experiments of Professor Hertz on electrical undulations, which were designed to verify the suggested identity of light waves with electrical oscillations of the ether. Faraday thought this might be true ; and Maxwell was also led to conclude that electrical action is transmitted through space by means of oscillations of the same order as the luminous waves ; the differences between the two phenomena depending only on the difference in the wave lengths. Prof. Hertz's experiments are now declared to have demonstrated : (1) That the medium which intervenes in the phenomena of electrical action is the same as that which is the seat of luminous phenomena ; (2) that both species of perturbations are propagated under the same conditions, and with equal velocity ; (3) that there is identity of nature between certain electrical and luminous phenomena. Moreover, it is stated that one of the greatest triumphs of Professor Hertz consists in having realized an arrangement whereby the length of the electrical wave is considerably diminished ; thus approaching the character of the luminous wave, and shadowing forth a prospect of the direct industrial production of electric light. Indeed, different sources of artificial light can be compared by other than photometrical methods. Thus the lamps may be inclosed in an opaque calorimeter which measures the total energy of radiation, and again in a transparent calorimeter which permits the light radiations to escape. The energy represented by the latter will then be measured by the difference between the two calorimetric determinations. Experiment has given the following results for the ratio of duty of different luminous sources which can be measured in this way as light, the total radiations being taken as unity : Candle, 0.00298 ; petroleum lamp, 0.00315 ; gaslight (kind not stated), 0.00317 ; oil lamp, 0.00442 ; incandescent electric lamp, 0.06 ; arc lamp, 0.1. Thus the electric arc lamp, which gives the highest duty of all, wastes nine-tenths of its energy in non-luminous, invisible heat rays. If these rays could only be quickened, they would appear as light ; and Professor Hertz is in hopes of being able to do something toward this end by manipulating alternating currents.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

It is likely that the bill before the West Virginia Legislature, which authorizes the authorities of Parkerburg, in that State, to take up the business of the manufacture and supply of electricity and gas, will be adopted. It has been reported favorably by the committee to which it was referred.

Mr. J. H. Caldwell, Superintendent of the Nevada (Mo.) Gas and Electric Light Company, writing under date of the 20th inst., informs us that gas was turned into the new holder on February 16th, and that the new vessel never gave them a moment's anxiety. This insures ample storage capacity on the works. The holder was built by the Eldridge Brothers, of Nevada.

A few days ago a slight fire in the engine room of the Flatbush (L. I.) Gas Company's works was seized upon by the local fire laddies as a fitting occasion to display their valor—and their red shirts. Hose, hand engine and hook and ladder manipulators were out in full force, and Chief Schimpt, noticing that a puff or two of smoke came from the engine room, ordered his men to "turn on the water." Superintendent Armington informed the "Chief" that neither his services nor those of his men could be of any particular service at the time, for the flames had been extinguished. The "Chief," however, was not to be put down thus easily, and the water was poured over fireless embers. Having vindicated his firemanship, the "Chief" withdrew. If the firemen had remained away the damage would have amounted to perhaps $15; but as the result of their stern adherence to duty, the damage has been assessed at $150.

The general offices of the Chicago Gas Company are to be removed to the handsome building, corner of Madison and Michigan avenues, owned by the Western Bank Note and Engraving Company. The lease is to run for 10 years, at an average rental of $10,000 per annum.

A correspondent at Richmond, Va., forwards the following : "What is troubling the serenity of our citizens to-day is the price they have to pay for gas. Why should they be called upon to pay $1.50 per 1,000 for gas, when it is shown that the cost of that quantity to the city is considerably less than 60 cents ? Such questions are asked with great frequency, now that the lighting question is so frequently before Councils, and that the impression constantly gains ground that gas is much cheaper than electricity. Only a few days ago a prominent citizen said: 'Why, I remember that some years ago a party of Richmond's capitalists offered to lease the city's gas plant, and agreed to pay to the city 6 per cent. interest on the capital invested in it. This offer was refused. I am perfectly ready now to form, with other men in Richmond, a company that will buy the plant for just what it cost the city, pay the 6 per cent. interest on the money invested by us, and guarantee to reduce the price of gas from 30 to 50 per cent. I mean what I say, and if I had the slightest thought that the Council would accept the proposition, I would at once submit it to them. Thus you can see how much money the city is making out of the plant, and how very unjustly the citizens are being treated.' Superintendent Adams makes to the Committee on Light a monthly report of the operations of the works, his statement for January having been as follows : Gas made, as per station meter, 25,547,200 cubic feet ; gas sent out, 25,533,607 cubic feet ; production, per pound of coal, 4.88 cu. ft. ; average illuminating power, 19.30 candles ; number of retorts used, 104 ; average make per day per retort, 6,700 cubic feet ; leakage and condensation 10 per cent. ; amount of coke made per ton of coal, 36 bushels ; coke used in retort house, 36,120 bushels ; coal used at station engine, 31 tons ; lime used in purification, 10,800 bushels. amount of coke sold, 36,462½ bushels ; lime sold, 1,326 bushels ; tar sold, 584 barrels ; receipts for sales of coke, etc., $3,197.18 ; cost of gas in holder, 48 cents per 1,000 cubic feet ; cost of distributing gas, 14½ cents. Probable sum required for February pay roll, $6,600. Putting one thing beside the other, it is reasonable to infer that the pressure of public opinion will compel a reduction in the gas rate."

The *Chaffer* is responsible for the following garb in which it dresses an old-timer : "*Quericus.*—What's that machine I stumbled over as I came through the hall ? Some new ventilating apparatus ? It was buzzing around like an electric fan. *Cynicus.*—Oh, no. That's only our gas meter. The men removed it in order to put in a new one, but it keeps on working just the same."

The following interesting figures are from the annual report of the Commissioner of Public Works, New York city: "The extent to which the streets are being torn up by private individuals and corporations is

shown by the fact that in 1890 they made 27,088 separate excavations for laying and repairing structures, conduits, gas and steam mains, and house connections, and that 53.72 miles of gas mains, 3.21 miles of car tracks and over one mile of miscellaneous pipes were laid aud 49 miles of trench opened for electric subways. In the extension and improvement of the sewerage system, 21,970 lineal feet of new sewers and 39 receiving basins were built. There are now on Manhattan Island 437.89 miles of sewers, with 3,248 receiving basins. During the year over 7 miles of new streets were provided with gas lamps. At the close of the year there were 27,114 gas lamps, 801 electric lights and 138 naphtha lamps lighting 512 miles of streets, docks and bridges, 66 acres of public parks, and 3¼ acres of public markets. The several gas companies now have 1,274 miles of gas mains."

AT the annual meeting of the Citizens (Brooklyn, N. Y.) Gas Light Company the following Board of Directors were chosen: Messrs. S. A. Lathrop, Frank Sullivan Smith, John Byrne, E. J. Dennison, R. T. Wilson, John H. Fisher and William Lewis Boyle. Messrs. Wilson, Fisher and Boyle take the places of ex-President Samuel E. Howard, John P. Rolfe and John W. Gordon. Mr. R. T. Wilson is President of the East Tennessee, Virginia and Georgia Railroad Company.

MR. HORACE WOODMAN, President of the Saco and Biddeford (Me.) Gas Light Company, has sold his holdings in that enterprise to Mr. Jere G. Shaw, of Biddeford. The latter now owns a controlling interest in the Company. Mr. Woodman will shortly retire from the Presidency.

THE proprietors of the Consolidated Gas and Electric Light Company, of Batavia, N. Y., have installed a new electric lighting plant of the Wood type.

ACCORDING to the sworn statements filed by the proprietors of the named companies, it would seem that capital is no object in the operation of electric lighting plants at Dedham and Hyde Park, Mass. The investment so far seems to stand as follows:

Dedham Electric Company, of Dedham.—Last annual meeting, July 15, 90; certificate filed September 10, '90; Treasurer, Thomas F. Robinson; fixed capital, $60,000; paid in capital $60,000. Assets—land, and water power, $3,430; buildings, $9,469; machinery, $31,482; cash and debts receivable, $3,369; manufactures and merchandise, $38,342; total, $86,095. Liabilities—capital stock, $60,000; debts, $25,005; profit and loss, $1,089; total, $86,095.

This Company was started about one year ago, with a capital of $25,000; so it will be seen that its progress in the line of piling up liabilities has been fairly rapid. The other link in the history (Dedham and Hyde Park adjoin) is as follows:

Hyde Park Electric Light Company, of Hyde Park.—Last annual meeting, August 26, '90; certificate filed September 6, '90; Treasurer, W. F. Pope; fixed capital, $50,000; capital paid in, $50,000. Assets—land, water power and buildings, $13,572; machinery, $75,832; cash and debts receivable, $4,519; manufactures, merchandise and street lines, $31,005; total, $124,929. Liabilities—capital stock, $50,000; bonds, $20,000; debts, $50,761; profit and loss, $4,167; total, $124,929.

The Hyde Park concern was started three years ago, with $20,000 capital, and, as in the preceding instance, its proprietors seem to have had no scruple in the matter of printing stocks and bonds. In any event, we are confronted with the fact that the amount so far invested for the supply of electric light in Dedham and Hyde Park is $211,024. On the other hand, it seems that the proprietors of the Dedham and Hyde Park Gas Company manage to get along quite comfortably on a total liability of $109,000.

THE Albany (N. Y.) correspondent of the New York *Herald*, in his budget from the lawmakers' headquarters, respecting the developments in the lawmaking district on the 24th inst., says: "Mullaney is a daisy. The *Herald* has paid its respects to several of his little bills already this session, but Dominick is not dismayed. He bobbed up serenely to-day with a star effort. Its title should be 'for the abolition of gas companies in New York city,' but it will have no title when the committee gets in its work. Dominick's bill provides that any citizen, business man or property owner in New York city may make a sworn complaint to the Board of Health that the odors from gas works are obnoxious, a nuisance and prejudicial to health. The Board must then within three days summon a jury of ten persons, living or doing business within two city blocks of the gas works. Five shall be residents and five property owners, but none shall have relations other than as consumers with the company. Failure to answer the summons is a misdemeanor. This jury is to be separately examined on oath as to the alleged nuisance, and the company cannot be represented by counsel or ask questions at the investigation. The inquest cannot last over ten days, and at its close, if the fact of a nuisance is proven, notice shall be served on the company within two days to abate the nuisance within 90 days. Two days after the service of this notice the company must execute a bond to the city, with sureties to be approved by the Comptroller, in the sum of $50,000, to abate the nuisance within the allotted time. Failure to execute this bond forfeits the charter. When the 90 days of grace are ended the Board of Health must visit the locality and see if its orders have been carried out. If the nuisance is abated, on their report the Comptroller shall release the bond. If not, it shall be forfeited, and the Board shall at once cause the arrest of the company's manager and engineer. On conviction they shall be punished by a fine of $1,000 each, or imprisoned for three months, or both. If further complaint is made within one year, and is sustained, the charter of the offending company is forfeited. Any member of the Health Board wilfully neglecting to carry out this law is guilty of a misdemeanor and liable to a $5,000 fine, or one year's imprisonment, or both. When the provisions of this measure became known in the Assembly, even the hardened members held their breath. Then they looked around for the bold Dominick, but he had escaped."

THE following "true bill" discloses the result of a thorough overhauling of the street mains of a Company in this State, the business of which is increasing in a very satisfactory way. The work of examination and repair was carried on during the months of September, October, and November, 1890:

Gas unaccounted for,	Dec., 1889.	171,400 cu. ft.,	or 11	per cent.
" "	Dec., 1890.....	56,100 "	" 3.8	"
" "	Jan., 1890.....	203,900 "	" 14.7	"
" "	Jan., 1891.....	43,700 "	" 3.4	"

Saving on leakage account in the two months, 275,500 cubic feet, which was achieved at an expenditure—labor, $226.61; tools, $10.50—of $237.11. Looking at it in another way: 277,500 cubic feet of gas was saved, which, at $2 per 1,000 (the average selling rate), was worth $551, and taking therefrom the total expense attendant upon the work of tightening the mains, we have right off a money gain of $313.89. A Connelly governor was put on the system on the 7th of last January.

THE San Antonio (Texas) Gas Light Company will put up an extension to their power house, at an expense of $2,500.

WE are in receipt of the following letter from Key West, Florida, under date of Feb. 19. As the contents thereof are very perplexing to us, we print the same in the faint hope that some one of our subscribers may unravel the snarl. We are sorry to have to say that the conundrum is too rich for the occupants of "No. 42 Pine street, top floor, front." Here is the mystery:

"Dear Sir—Since I have seen your grand offer, and wishing to know something more about it. To me it is strange to know how you can sell a machine for one dollar. Please teach better of the facts, and I will be very glad if you will. It seems somewhat a matter of impossibility for it to be. Please write me early, and I shall remain yours, in sincerity and truth, WM. A. ALBARY, Gas House, Key West."

WE are indebted to the courtesy of D. M. Dunning, Treasurer and Superintendent of the Auburn (N. Y.) Gas Light Company, for the following particulars respecting the damage occasioned by a recent storm to one of the holders on that works: "Our holder accident was caused by a violent wind (so fierce that a man could not remain in a standing position on the holder crown) and a heavy weight of wet snow, together with structural weakness of holder; especially of bottom curb. The holder, which was 60 feet by 20 feet, with a capacity of 57,000 cubic feet, was built by the Messrs. Merrick, of Philadelphia, in 1869. The 6 columns, also, were light. We have made no attempt to restore it, and shall probably decide to build a new telescopic holder in same tank, to be covered with a brick house—we need additional storage capacity. We are getting along very well with a smaller holder of 35,000 cubic feet capacity, and although we are sending out 120,000 cubic feet in the 24 hours, we have not failed to supply our consumers—even on the night following the accident, which happened Monday noon, 9th inst., when both holders were nearly filled."

THE Laclede Gas Company has purchased the plant and franchises of the Municipal Electric Lighting Company, and the Missouri Electric Company of St. Louis, and is, therefore, in complete possession of the right to supply gas and electric light in that city.

THE following bills have been introduced in the lower branch of the Ohio State Legislature:

House Bill, No. 948; introduced by Mr. Willis: "Section I.—Be it enacted by the General Assemby of the State of Ohio, That in any city or village in the State, where there is or hereafter may be a gas company supplying gas to such city or village, the authorities of such city or village are authorized to make inquiries into the kind and character of the material or materials used in the manufacture of such gas, the cost of the same, and the profit on the gas furnished. Section II.—That the manager of any gas company refusing to furnish at any time when called upon the information named in Section I. of this act shall be deemed guilty of a misdemeanor, and may be fined in any sum not exceeding one thousand dollars, nor less than one hundred dollars. Section III.—This act shall take effect on its passage."

House Bill, No. 1,008; introduced by Mr. Hodge: "Section I.—Be it enacted by the General Assembly of the State of Ohio, That any municipal corporation may establish, own, or operate any gas or electric light plant, or any street railroad within the limits of such corporation, as the law-making power or powers of such corporation may deem for the public good; *provided*, that when any franchise has been granted for the establishing of any gas or electric plant, or any street railroad, and the same is in force, before establishing, owning or operating any gas or electric light plant or street railroad covering the same territory, such corporation shall pay to the owner or owners of such existing gas or electric light plant or railroad, the value of such franchise and of all fixtures and effects used and necessary in operating the same; and the value of the same shall be determined by five freeholders living within the county in which such municipal corporation is situated, to be appointed by the judge or judges of the Court of Common Pleas having jurisdiction in such county. Section II.—That it shall be unlawful for any city council, common council, or other municipal authority in any city or village of this State to give or grant any special franchise or extend any such franchise already granted, except as herein provided. Whenever any such franchise is asked for or to be given, either as an original grant or as an extension of a grant already bestowed, it shall be the duty of the authority or authorities having control of the matter to advertise in one or more newspapers of general circulation, once each week for four weeks, for proposals for the same, and the person or persons offering to pay the most for such franchise, or to pay the largest percentage of the gross earnings obtained in conducting the business carried on under such franchise, shall be given the same; provided, that all bids may be rejected and new proposals advertised for. Section III.—That any municipal corporation offering for sale any franchise may adopt such rules and regulations for the government of such sale not inconsistent with the provisions of this Act as may be deemed calculated to secure *bona fide* and responsible bids, protect private rights and serve the public good. Section IV.—That whenever any municipal corporation shall grant any franchise as herein provided, whereby any person or persons now or hereafter holding any franchise shall be superseded in their rights, the grantee or grantees of such new franchise shall pay the former owner or owners of the said former franchise for the fixtures and effects held by them, used and necessary in operating the same, and in default of a mutual agreement between said parties as to price and terms, the same may be determined by a commission of freeholders as named in the section of this Act; provided, application for the appointment of such commission shall be made by the owner or owners of such former franchise to such judge or judges within 10 days after the expiration of such original or previously held franchise. Section V.—This Act shall take effect on its passage."

COLONEL HENRY HALE has been elected President of the Salem (Mass.) Gas Light Company.

EDWIN YOUNG, as executor of the estate of Thomas Cornell, has sued out an injuction restraining the consolidation of the Kingston (N. Y.) and Rondout Gas Light Company and the Kingston Electric Light, Heat and Power Company.

A TYRONE (Pa.) correspondent, writing under date of the 19th inst., says: "For some years past no great amount of good feeling has existed between the residents and the Hollidaysburg Gas Company, and when, a few months ago, the home company sold out to the Brooks Process Company, there was much rejoicing at the prospect of cheap gas. The rejoicing subsided, however, when the price was raised to $1.50 per 1,000, and when, on February 1st, the rate was increased to $2 per 1,000, the kicking was sufficiently pronounced to make even a vicious mule blush. At this juncture, Mr. Harold J. Bell, representing the Toraya Wood Gas Process Company, appeared on the scene, whereupon a stock company was formed. Now a new set of works and mains will be put in and the old Company's capital will be sacrificed. At least that is the way it looks to C. H. D."

THE authorities have granted the franchise for a gas works at Rutherford, N. J., to Mr. Van Steenbergh and his associates.

LAST week a Court of Appeals decision was promulgated dismissing the appeal made by the Attorney-General of the State on behalf of the Williamsburgh Gas Light Company against the Equity Gas Light Company, of Brooklyn, N. Y. This means that the proprietors of the latter Company are now free to proceed under their charter. Construction work, which has been underway for some time, will be vigorously prosecuted, under the direction of the Equity Gas Works Construction Company, the offices of which are in the Equitable Building, this city.

THE rate war at Rochester, N. Y., has been brought to a close, and the residents are now paying peace prices—$1.80 gross; net, $1.60.

WE are in receipt of a very handsomely prepared set of "briefs," issued at the instance of the Colorado Springs (Col.) Lowe Gas and Electric Company, for the purpose of calling the attention of the residents to the value, comfort, reliability, and economy of gas as a cooking, heating, and power agent. The "briefs" are profusely illustrated, and the printed matter is well selected. The whole arrangement is most praiseworthy, and is thus a credit to its designers, who have spared neither labor nor expense in putting it out to their customers—present and prospective.

MR. R. F. KNAPP, who was recently appointed Receiver of the Consumers Electric Light and Gas Company, of Saratoga Springs, N. Y., is said to be inquiring as to the cause for or reason of his appointment. There does not appear to be anything to "receive."

THE Cincinnati Gas Company has purchased the property on Front street, formerly owned by the Globe Rolling Mill Company. The plot has 248 feet on the street line, and its rear line is on the Ohio river.

THE Selectmen of Melrose, Mass., recently voted to petition the Legislature for authority to build and operate, on municipal account, a gas and electric lighting plant.

AT the annual meeting of the South Bethlehem (Pa.) Gas and Water Company, the following Directors were chosen: E. P. Wilbur, R. H. Sayre, W. H. Sayre, H. S. Goodwin and William V. Knauss.

THE proprietors of the Newton and Watertown (Mass.) Gas Light Company have elected the following officers: President, Joseph N. Bacon; Clerk and Treasurer, Francis Murdock; Directors, J. N. Bacon, G. C. Lord, C. C. Walworth, Wm. Claffin, C. M. Seaver, J. K. Stickney, Francis Murdock, H. L. Hovey and Abraham Avery.

ANOTHER very cleverly arranged pamphlet, showing the advantages of gas cooking, etc., is that recently issued by the City Gas Company, of London, Ontario. The pamphlet, which is a model of neat typography and careful presswork, is chiefly taken up with testimonials from residents of the city who, having tried gaseous fuel, and not found it wanting, are willing to bear testimony to its value. Letters from 56 separate users are printed; and, altogether, their evidence, which is most complete, ought to make many new customers for the Company.

THE Standard Gas Fixture Company, which succeeds to the business of the Empire Gas Fixture Company, at Bound Brook, N. J., has been incorporated. Its President is Mr. W. W. Tunison.

AN auxiliary water gas plant of the Wilkinson type will be installed at the works of the Newark (N. J.) Gas Light Company, the proprietors whereof have secured the exclusive right to manufacture gas under the Wilkinson process in Essex and Hudson counties, N. J. The iron work for the plant at Newark will be put in by Messrs. Bartlett, Hayward & Co., and Fred. Bredel, of this city, will furnish the fire clay materials.

MR. GEORGE G. RAMSDELL has been appointed General Manager of the American Gas Company, of Philadelphia. He assumes his new duties to-day. We sorrow with Vincennes, rejoice with Philadelphia, and "shake" with Ramsdell, who deserves his promotion.

THE Stacey Manufacturing Company, of Cincinnati, has been awarded the contract for the new holder (three lifts, with total capacity of 2,000,000 cubic feet), to be completed this season for the Cincinnati Gas Light and Coke Company.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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AGENTS.

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MONDAY, MARCH 2, 1891.

The Market for Gas Securities.

Quietness again ruled in the stock market the past week, and Consolidated developed unmistakable signs of weakness. It sold down as low as 96, and to-day's opening (Friday) was made at 96 to 96¼. There is no good reason for the decline, and not much stock was marketed. The bears may have speedy reason for regret at the liberties they have taken with Consolidated quotations. Other city shares show no change, although Equitable has been inquired for, in small lots. The Brooklyn situation remains unchanged, and figures are well maintained in all classes of shares in that city. The Equity Company's works will, on the authority of Mr. H. E. Fanshawe, be completed at as early a date as possible. Chicago gas is strong, at 42½ to 42⅝, and there is active trading in the security. Baltimore Consolidated is rather weak, our last regular quotation coming in at 47 to 47¼.

Laclede common is at 17 to 18, and better prices ought speedily be made in it, on account of the recent purchase by the Company of the two independent local electric lighting concerns. Bay State has not recovered from the recent decline, nor do we think a permanent advance or settled value can be given the shares until the rate question is determined. Sixteen shares of Salem (Mass.) gas were recently sold at 120, and 3 shares of Beverly (Mass.) gas brought 105. Cincinnati improved sharply on a late heavy purchase of real estate, coupled with the reports of great gains in the sendout. The general situation seems to favor higher prices, particularly in the Eastern and Middle States. One feature of the market is the increased attention given by investors to gas bonds.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

MARCH 2.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	96	96¼
Central	500,000	50	—	85
" Scrip	220,000	—	95	100
Equitable	4,000,000	100	117	120
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	116	120
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	—	48
Preferred	5,000,000	100	—	90
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	117	120
Citizens	1,200,000	20	85	90
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	130	132
" Bonds	300,000		100	105
Peoples	1,000,000	10	91	92
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	103	105
Nassau	1,000,000	25	134	—
" Ctfs	700,000	1000	95	100
Williamsburgh	1,000,000	50	130	—
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	—	87
2d " " "	3,000,000	1000	—	75
Bay State Gas Co.—				
Stock	5,000,000	50	—	58
Income Bonds	2,000,000	1000	95½	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds.	45,000	—	—	—
Chicago Gas Company.	25,000,000	100	42½	42⅝
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	100	84¾	85½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	98
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	100
2d "	2,500,000	1000	94	98½
Consumers Gas Light Co., Jersey City	2,000,000	100	12	15
Bonds	600,000	1000	70	75
Cincinnati G. & C. Co.	6,500,000	100	204	205
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal.			92	100
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	47	47¾
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	110
Bonds	250,000		—	—
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn.	750,000	25	102	108
Jersey City	750,000	20	165	170
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	17	18
Preferred "	2,500,000	100	55	60
Bonds	9,034,400	1000	81	81¾
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	40	—
" Bonds.	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal.			34¼	35½
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	58½	59
Washington, D. C.	2,000,000	20	200	208
Wilmington, Del.		50	88	90

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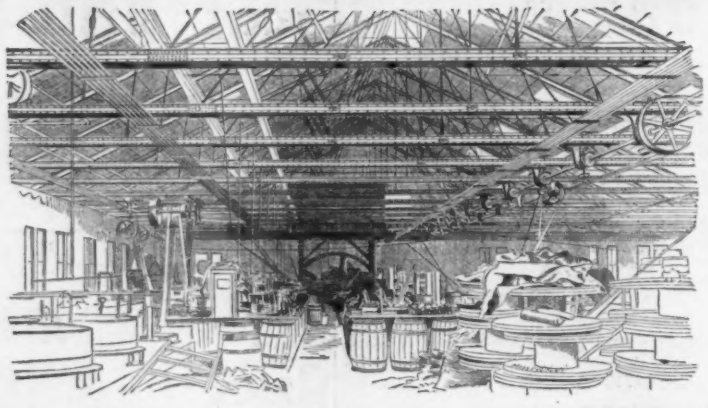

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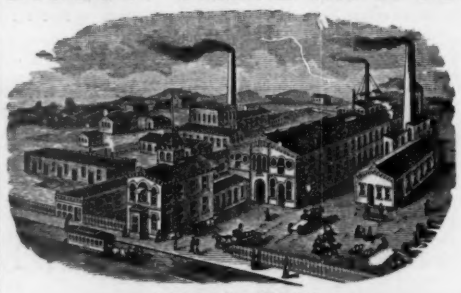

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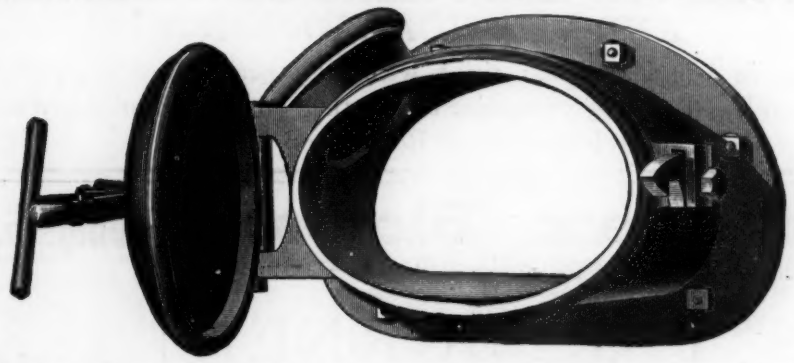

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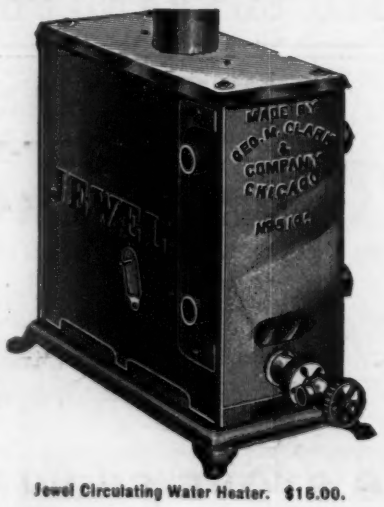

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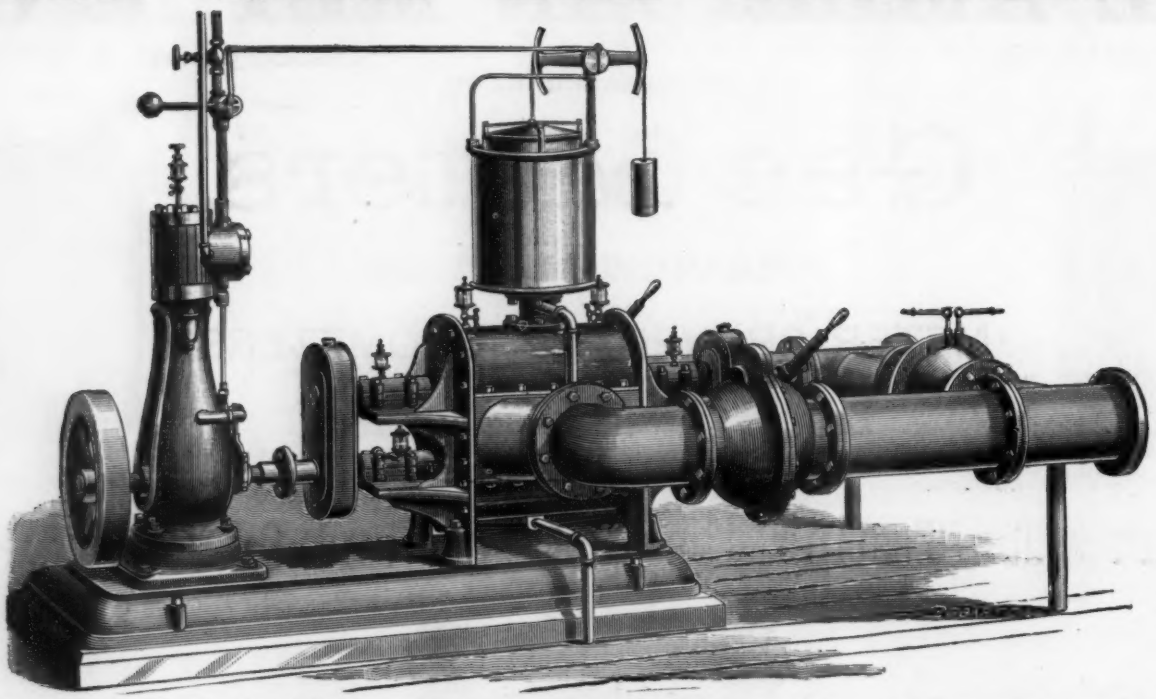

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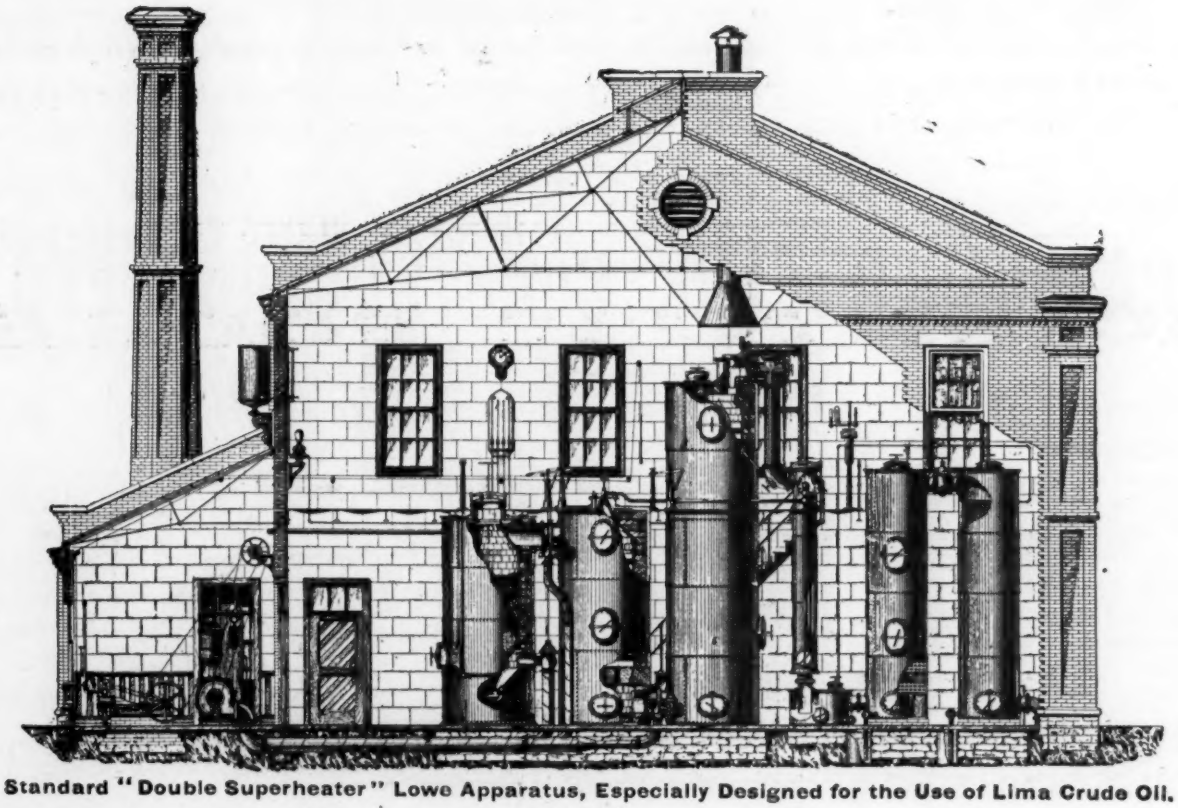

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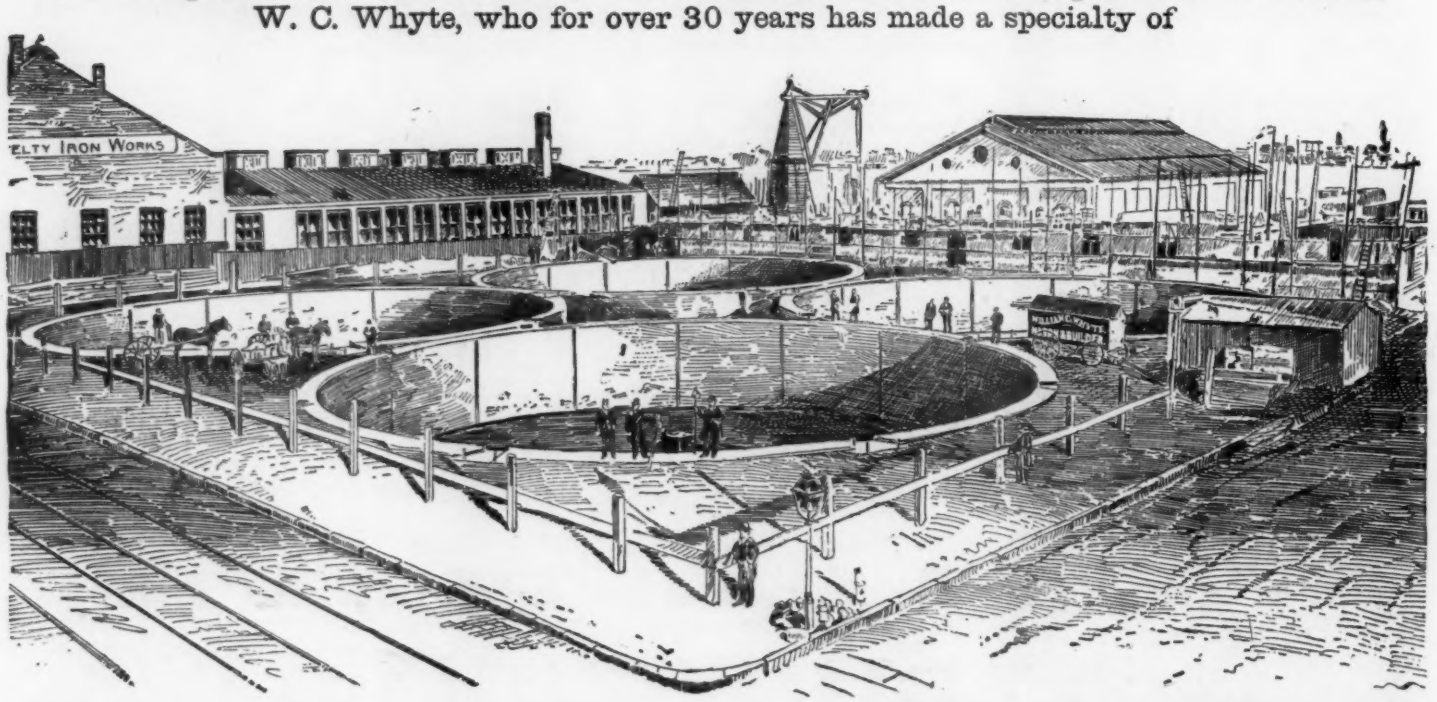

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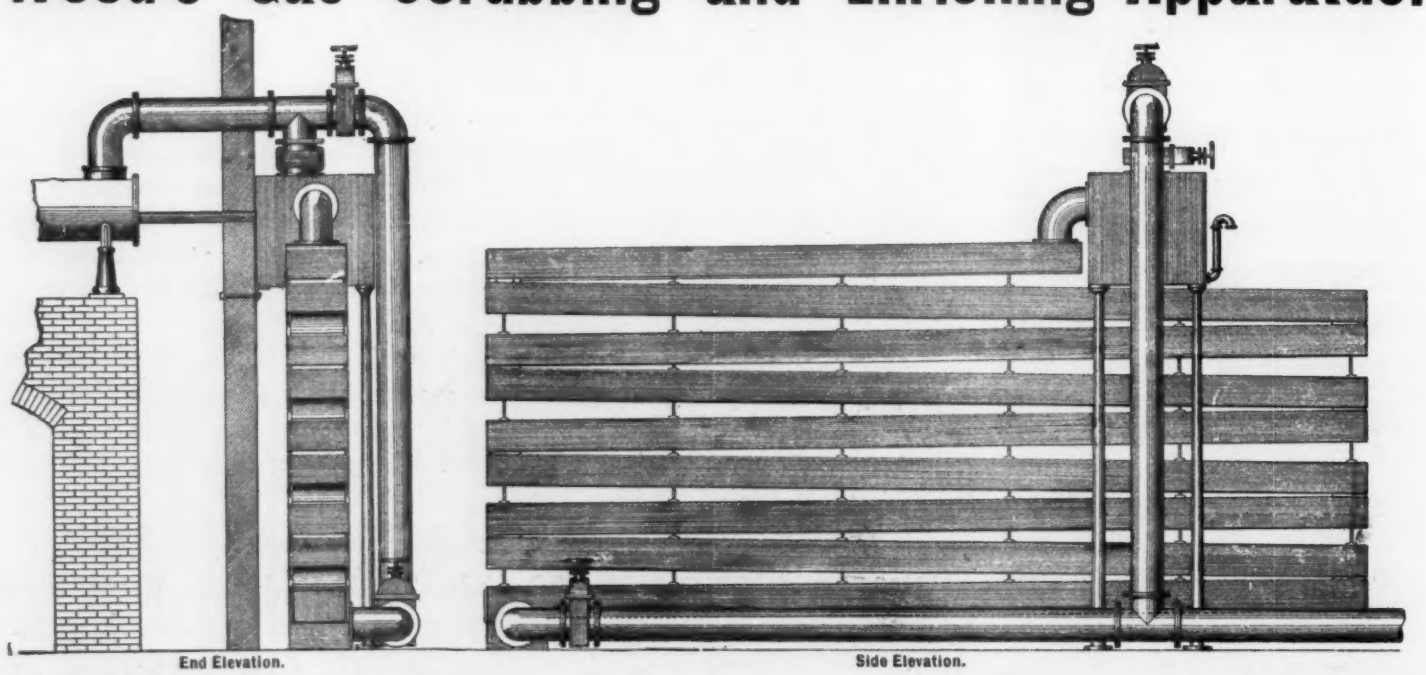

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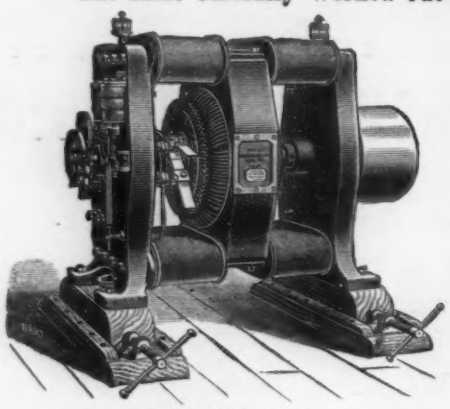

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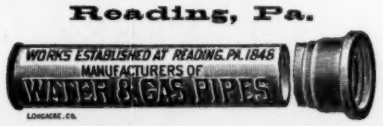

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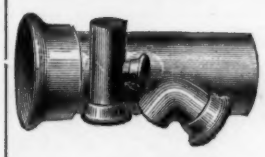

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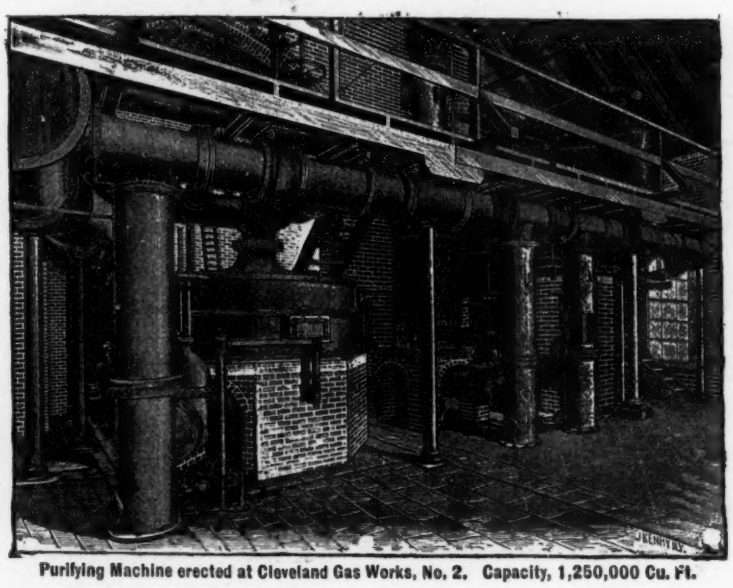

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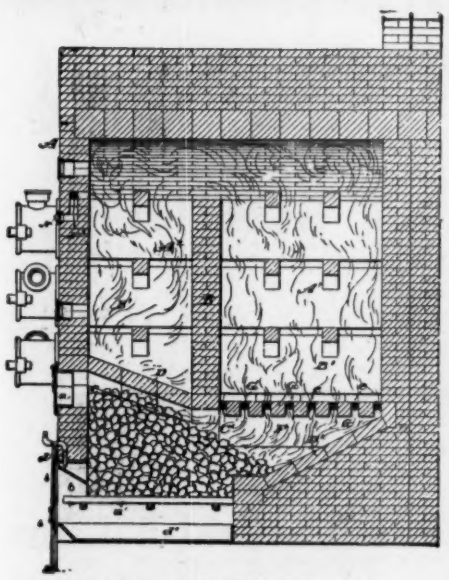

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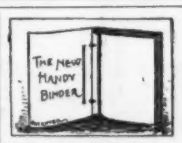

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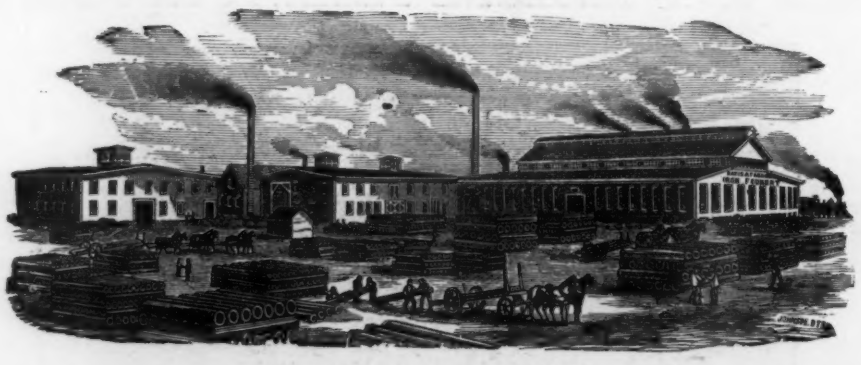

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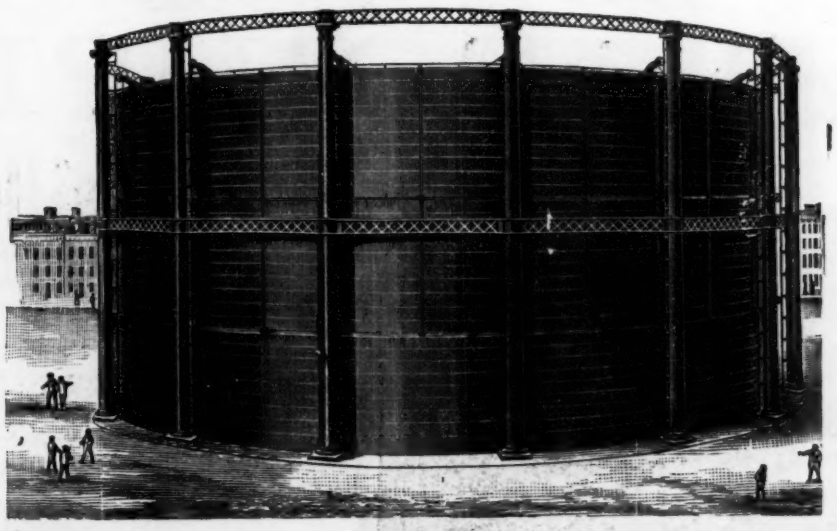

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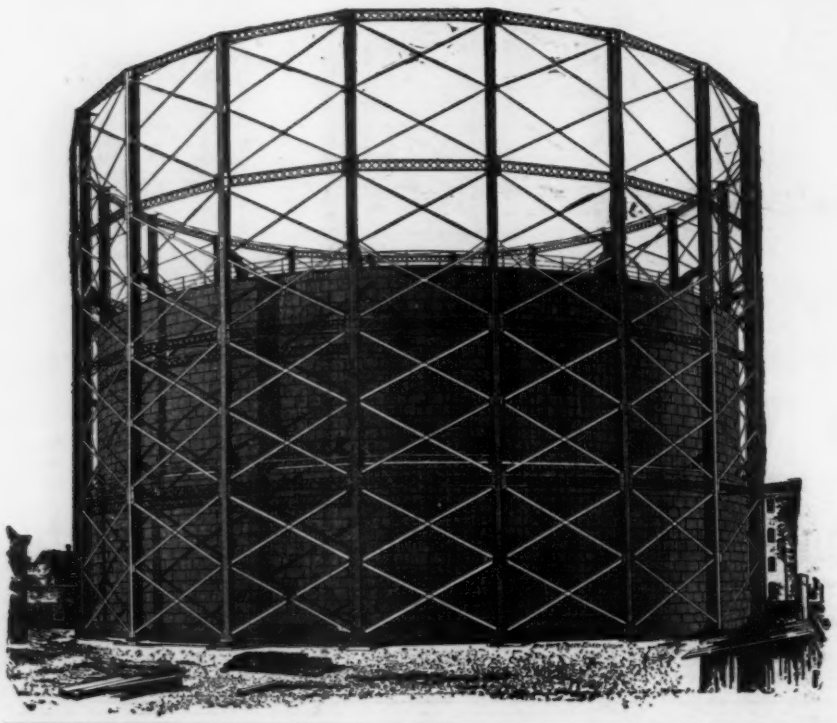

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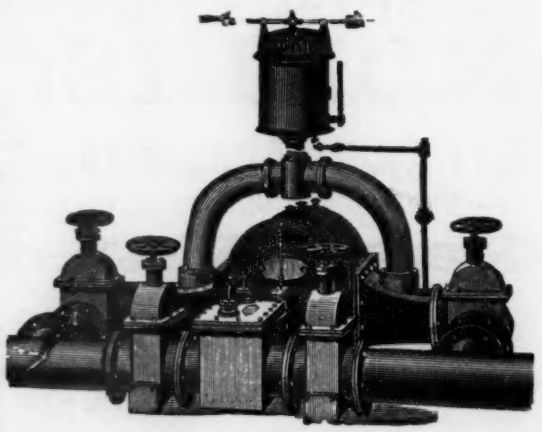

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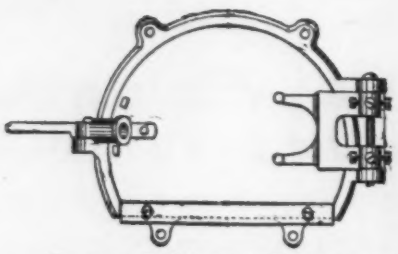

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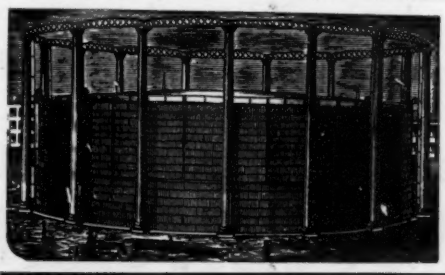

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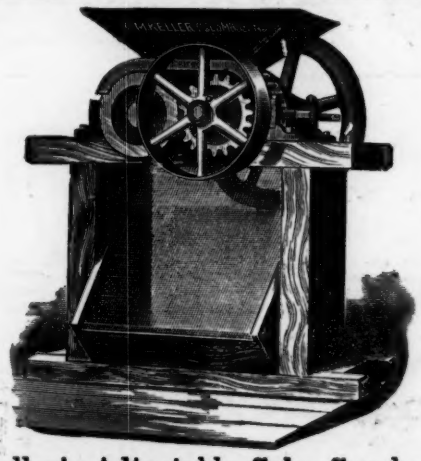

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SIMPLE, STRONG, AND DURABLE.

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The utility and convenience of the Gas Engine being no longer an open question, it only remains now for intending purchasers to select the BEST. We claim for the CLERK GAS ENGINE that it is equal to any other manufactured as regards steadiness in running, simplicity, and ease of keeping in repair, and that it gives the greatest amount of power for the least money (both in first cost and expense of running) of any engine made. In support of this claim we refer to the test of the Gas Engines made under the direction of the American Institute of New York, in December, 1885, and heretofore published in these columns. These engines are especially adapted for continuous running under heavy loads, and we can refer to Engines which have run 22 hours a day for months at a time

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Manufacturers of the "SUN DIAL" GAS STOVES, for Cooking and Heating.

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We use only the very best materials, and employ the most skilled labor, and by our long experience (36 years) and personal supervision of every detail we fee justified in assuring the public that our goods will give perfect satisfaction. Every Meter emanating from our establishment will bear the State Inspector's Badge, and will be fully warranted by us. Our Annual and Calendar will be sent to Gas Companies upon application.

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The Most Economical, Efficient, and Durable Gas Stove Made.

GAS COOKING STOVE, No. 8 C.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
37 in. high.	12 in. high.	12 in. high.	24 in. long.	36 in.
20 in. wide.	17½ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.

Consumption of gas with all burners in use, 42 feet per hour, at 1 inch pressure.

The top is made in sections, so that a greater variety of cooking utensils may be used. By lifting out the covers and crosspieces and putting in a suitable forked ring, which is sent with each stove, a wash boiler or other large utensil may be set over two burners. Our **No. 87 GRIDDLE** also fits in the same position. The roasting oven is provided with a cast-iron door.

All Fittings are Nickel-Plated.

GAS COOKING STOVE, No. 7 B.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
31 in. high.	9½ in. high.	10 in. high.	21 in. long.	32 in.
17 in. wide.	14½ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has three boiling burners in the Top or Hot Plate, and one single oven burner.

This cut represents our New Style Cooking Stove. As will be seen, it has an ornamented cast-iron Base and Front, and extension shelves. The Oven Burner, which is atmospheric (unless otherwise ordered), is of an entirely new and improved pattern (patent). The ovens are of greater capacity than those of the old style. The Top, in conjunction with the Outlet Pipe, is designed to carry off all the products of combustion, if desired, but they are also supplied with a loose ring which converts it into an ordinary open top stove.

The consumption of this Stove is 35 cubic feet per hour at 1 inch pressure, with all Burners in use.

All Fittings are Nickel-Plated.

"RADIANT" BOILING STOVE, WITH REGENERATIVE BURNER.

Size, 6½ inches diameter, 8 inches high. Consumption, 6 feet per hour at 1 in. pressure.

HOT PLATE, No. 111.

Size, 36 in. long, 12 in. wide, with three double burners, 6 taps.

Consumption, with all burners in use, 36 cubic feet per hour, with 1 in. pressure.

¾ in. supply pipe should be used where the pressure is 1 in. or over.